POWER PLANT ENGINEERING

GENERATION - TRANSMISSION - DISTRIBUTION - UTILIZATION

Contents

Hydrargyrum 328

With the Editors 329

Standardization of Effort. Local Power Plant Committees Being Formed. On Spectacles in General.

Chicago Entertains Engineers and Scientists 330

Mechanical Engineers Present Research Findings 333

Electrical Engineers Discuss New Developments 336

Testing, Heating and Refrigerating Engineers Present Papers at Chicago Meetings 338

Smoke Abatement Association's Convention 341

Power for the New City Hospital at Springfield, O. By G. B. Zeller 342

Extraction Heaters in the Power Plant. By Gustaf A. Gaffert 346

Small, High Efficiency Boilers for Isco Chemical Co. 348

Design of Compressed Air Piping for Industrial Power Plants. By Henry C. Moffett 349

Induction Motor Pointers. By Carl Heyel 351

Measurement of Temperature in Electrical Windings. By A. C. Finney 352

Transformers in Open Delta. By V. E. Johnson 353

Features of Outdoor Mercury-Vapor-Steam Plant 354

Maintenance of Diesel Engine Valves. By Richard Howarth 357

Readers Conference 358

Are Your Equipment Cases Alive? Making Anti-friction Bearings Long Lived. Water Hammer in Lancashire Boiler. Operator's Carelessness Shuts Down Large Steel Plant. Waterproofing Tank Surface. Motor Foundation.

Sixth Chicago Power Show Held in Stevens Hotel 361

Electric Control Valves. Babcock & Wilcox Multifuels Burner. New Collector Ring Grinder. Burgess Micro Switch 363

Direct Externally Guided Expansion Joint. New Whipcord Transmission Belt. Four-Duty Coupling. Expansion Joint for 400 lb. New Sarco Trap 364

Boiler Manufacturers to Formulate Code of Practice 364

News from the Field 365

For the Engineer's Library 365

Contents of back issues of Power Plant Engineering will be found in Industrial Arts Index on file in Public Libraries.

AUGUST
1933

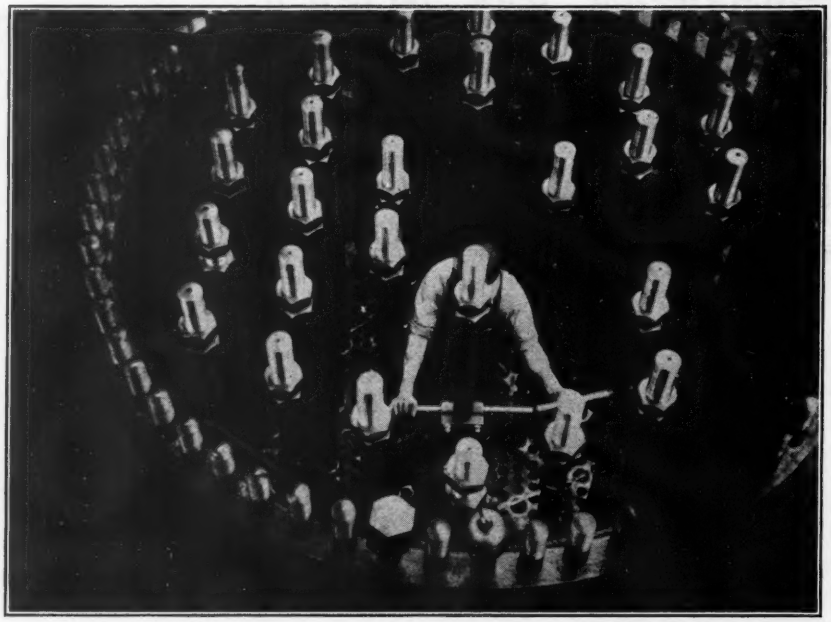
Vol. XXXVII., No. 8

Published on the first of each month, copyright 1933 by the
Technical Publishing Co., 53 W. Jackson Blvd, Chicago.
New York Office, 171 Madison Ave.

EDITORIAL STAFF: ARTHUR L. RICE, Editor. R. E. TURNER, Managing Editor.
A. W. KRAMER, RICHARD H. MORRIS, Associate Editors.

Subscription price. U. S. A. $2.00 a year; other countries, $3.50 a year. Single copy current issue, 25c; other countries, 35c. January 1 issue, U. S. A., 50c; other countries, 60c. Back issues; single copy, U. S. A., 40c; other countries, 50c. January 1 issue, U. S. A., 75c; other countries, 85c.

Member, Associated Business Papers, Audit Bureau of Circulations.
Circulation of this issue 21,350



Assembling the steam dome of the condenser-boiler for the Schenectady mercury-vapor-steam installation

Hydrargyrum

TO THOSE of you who know your chemistry, this rather formidable looking word will present no mysteries or if you studied Latin in your younger days, perhaps you can figure out what it means without great difficulty. Let us see—it starts with hydra and hydra, we know, is Latin for water. It must have something to do with water. Well, it does and it doesn't. It means *water silver* but today we know it as mercury and that, we know, has little or nothing in common with water except its liquidity at normal temperatures.

Mercury has always been a fascinating element and we don't blame the ancients for calling it water silver; it is a good name. It was always a favorite with the old alchemists and its properties have long made it valuable in many fields. Its best known use, perhaps, is in thermometers; indeed, here it is so well known that, despite the fact that many ordinary thermometers have no mercury in them at all, they are assumed to have and instead of referring to temperature we say "the mercury is rising or falling" as the case may be.

Notwithstanding its wide use in many fields, it was a bold move to propose its use in a boiler instead of water for power purposes. But engineers and scientists have never been timid in trying new things, and so it was inevitable that mercury should be considered for this purpose.

Some twenty years have passed since this proposition was first made by Mr. Emmet and during that time, first at Schenectady and later at Hartford, the technique of its use in boilers and turbines has steadily advance, so much so, that about two years ago, two large units of about 20,000 kw. capacity each were proposed. The design and construction of these plants have been regarded with considerable interest and we are pleased to present in this issue a short description of one of these plants, that at Schenectady serving the General Electric Co. works. Oh yes, we almost forgot, the picture above shows one of the steam domes of the condenser boiler of the Schenectady installation being assembled on the shop floor. The vertical rods are the stay bolts.

We mentioned thermometers in one of the foregoing paragraphs. Thermometers are always handy things to have about if for no other reason than to start or settle arguments about the weather. For some purposes, however, ordinary thermometers are a bit awkward. When one wishes to determine the temperature inside the windings of electrical equipment, for example, it is impractical to stick a thermometer in them, so other means are employed. Several schemes are available but some seem to be better than others. For this reason, the article on page 352 on the Measurement of Temperature in Electrical Windings is of interest. It discusses the problem simply and presents the advantages and disadvantages of the various methods available in commercial practice.

It is scarcely necessary here to direct attention to the articles in this issue dealing with the scientific and engineering conventions held in Chicago the last two weeks in June but we do wish to point out that despite their number, the papers presented at these meetings contain a great deal of valuable information and that it behooves every up-to-date engineer to familiarize himself with them. In the limited space available we could not of course present information on all of them but we have endeavored to discuss those of greatest interest in our field and so commend these articles to your attention. Aside from the purely engineering papers those of a primarily scientific nature were intensely interesting, particularly those dealing with modern atomic theory and on the disintegration of the atom. Progress in this direction is extremely rapid and, as Dr. Karl Compton put it, we are on the verge of some of the most exciting and far reaching developments in the whole history of science.

In fact, there has already been enough discovered to create considerable scandal. Hydrogen, the ne plus ultra of blue bloods, with a snooty self-assumed atomic weight of unity, has a number of black sheep in the family with an atomic weight of 2. Lawrence uses these heavy babies to break up the family life of many other elements.

WITH THE EDITORS

Standardization of Effort

LACKING THE FANFARONADE of more individualistic effort, standardization has been carried forward by hard work until it represents the most tangible, and in some cases only, accomplishment of our various engineering societies. Even though hampered by petty politics, by the selfish interest of individuals and manufacturers, by those unwilling to work for a cause offering little opportunity for personal glory, the work has gone forward slowly but surely.

Codes formulated, standards set up all mean elimination of wasted material, time and effort. Savings of material, of actual dollars, is perhaps the least important although it has been this feature that has largely supported the work. At this stage of development of our society or civilization it is doubly important that the results of various investigators be correlated so as to save duplication of effort and waste of time in reaching a common objective, so fundamental tests must be made on a common basis with procedure standardized.

To this end the various engineering societies have set up internal machinery which is a model of organization functioning almost automatically. What the engineering societies now need to justify their further support is a broadening of this procedure to coördinate and unify individual efforts. Until engineers can unify their efforts we must look to politicians to solve national and international problems which depend primarily upon engineering solutions. The skeleton of such a central organization exists, what it lacks to be effective is executive authority.

Local Power Plant Committees Being Formed

WHEN THE National Electric Light Association dissolved, one phase of its activities, the Prime Movers Committee, was left without sponsorship. It is safe to say that no agency in the country has done as much for the advancement of economy and safety in the generation of power as has the Prime Movers Committee and great disappointment was felt among power plant engineers when the Edison Electric Institute decided to disband this committee, albeit the Power Generation Committee will carry on many of the functions of the Prime Movers Committee.

Probably more than any other feature of the Prime Movers Committee work was the coöperative effort put forth by its members to solve the problems of power generation. Research, investigation, experiment and bold pioneering were engaged in by member companies and their results reported to the committee for the use of the industry.

Many of the former members of this committee are reluctant to sit passively by and let opportunities for improvements be neglected because a functioning organization is lacking. As a result local and sectional organizations are being formed throughout the country whose functions are quite similar to those formerly carried out by the Prime Movers Committee.

One of these, known as a Mechanical Power Plant Committee in the Metropolitan Section of New York could well serve as a pattern for engineers in other sections. Membership consists of engineers of companies in the public utility field including electricity, gas, railway and district heating services. Monthly meetings are held for discussion of perplexing problems and inspection trips. No dues are collected and the expenses, borne by the employing companies, consist only of the representatives' time and traveling costs in case of inspection trips. Coöperative efforts of this sort deserve the support of the companies represented on the committees, as through them lies the greatest opportunities for improving power plant economy.

On Spectacles in General

AS A SPECTACLE Engineering Week at the Fair will undoubtedly go down in the history of engineering societies as a memorable occasion. In contemporary history it will go down as a blunder chargeable perhaps to staff stupidity, perhaps to inadequate Century of Progress publicity, perhaps to traditional sectional jealousies.

Admittedly authentic details regarding the Fair exhibits were not easy to get even as late as April of this year, still, practically all the societies have Chicago representatives who should have been more or less familiar with general arrangement and all societies were represented on the National Advisory Committee by capable men who should have been consulted when programs were laid out.

What excuse, therefore, can be made for arranging a program so full that only a few hours of an entire week were left open for the society members to benefit by a visit to the World's Fair, the principal theme of which is the accomplishments of engineers and scientists?

With unlimited time at the disposal of visitors such a program might have been practical but most of those attending were undoubtedly limited to a maximum of a week or ten days. This period of time could all be spent profitably by most engineers in a study of the serious, scientific portion of the Fair without considering the carnival or amusement section which is of necessity an integral part of such a trip.

Every science is presented in a fundamental and interesting way; nearly every industry is represented by a working exhibit. It is possible to see almost anything from shirts to automobiles made on the grounds. Such a compact arrangement of inspection trips has never before been possible, yet, for this entire exhibit, which will be available but a few months, important engineering societies filled up morning, afternoon and evening with scheduled sessions and allowed on the program only a few hours to see the Fair.

It is to be hoped that the many disappointed society members who attended the meetings will impress upon their officials that the distinct advantages of congregating with others of their profession, are the personal contacts made and opportunities the locality has to offer for studying industrial problems and sightseeing. Few indeed are the papers presented and discussed that cannot be assimilated better in the printed form.

CHICAGO Entertains E

For two weeks from June 19 to July 1 Chicago was host to thousands of engineers and scientists from all over the nation. Hundreds of interesting papers were presented at scores of well attended meetings.

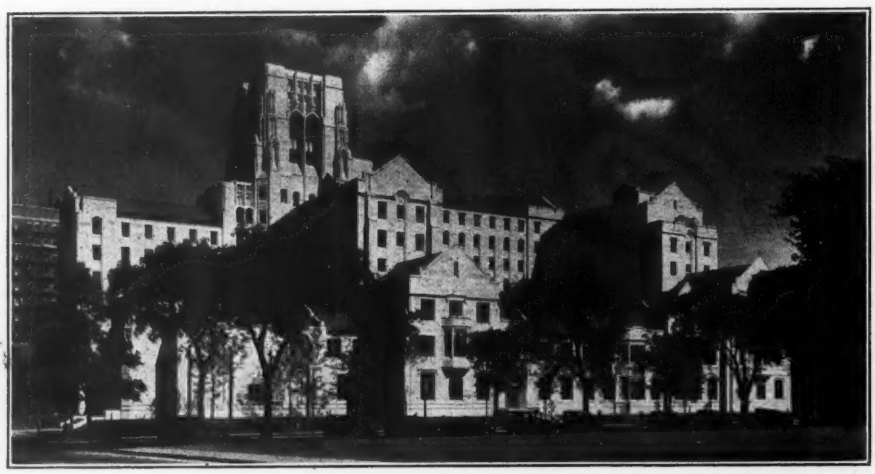
CHICAGO, DURING the latter half of June, was the Mecca of scientists and engineers from all over the world. For two weeks at the meetings of the American Association for the Advancement of Science and at the scores of sessions of the other engineering society conventions, they discussed problems of mutual interest and exchanged ideas and opinions on questions which covered every conceivable range of human thought. The meetings of the American Association probably were the greatest in the history of the association and all of the engineering sessions were exceptionally well attended.

The setting was perfect. A Century of Progress Exposition, more than any other world's fair, is dedicated to the effects of scientific discovery on the life of mankind, and it was fitting and proper that the meetings of these great scientific bodies should take place at the scene and at the time of this exposition. In addition to the exposition, Chicago's two great universities, Northwestern and Chicago, coöperated to the utmost toward the success and interest of the meetings. These attractions as to location and facilities, coupled with the attendance of a distinguished list of American and foreign scientists, provided unequaled opportunity for those able to attend the meeting. In fact there was entirely too much. With the scores of simultaneous sessions it was impossible for an individual to attend all those in which he was interested. This applied both to the meetings of the A.A.A.S. as well as to the A.S.M.E. and other engineering societies.

The range of thought covered by the hundreds of papers presented at the sessions was truly prodigious. Every field of scientific work was represented and the length of the program was such that the meetings extended over twice the usual period, that is, over two weeks instead of one. The first week was devoted more to the pure sciences, physics, mathematics, astronomy, etc., the second week the meetings were held largely in conjunction with affiliated engineering societies and these, of course, covered the application of the sciences. In this general discussion of the activities as a whole we will confine ourselves largely to the features of general interest during these two weeks since the strictly engineering conventions are described in other articles in this issue.

Engineering Week

Aside from the purely technical sessions there were, of course, many events of especial importance. The last week, that is the week of June 26, because of the many engineering societies in convention, was designated Engineers' Week, and the Wednesday of that week was Engineers' Day at A Century of Progress. There were no sessions that day so as to give all members and guests an opportunity of attending the exercises at the Soldiers' Field Stadium in the morning and of spending the rest of the day at the exposition. The exercises at the Stadium included the presentation of the Daniel Guggenheim Medal to Juan de la Cierva for his development of the theory and practice of the Autogiro. This was quite an impressive and interesting ceremony because the recipient of the medal flew direct to the stadium and landed his Autogiro on the field, a few feet away from the speakers' platform, while the spectators were assembled for the event. The Daniel Guggenheim Medal was created for the purpose



International House

At the University of Chicago where many of the meetings were held

Engineers and Scientists

The Fair Grounds at Night

of honoring persons who make notable achievements in the advancement of aeronautics, the medal fund being directed jointly by the American Society of Mechanical Engineers and the Society of Automotive Engineers.

On the opening night, that is the evening of June 19, A Century of Progress gave a reception to the members of the American Association and its affiliated societies in the Hall of Science. This gave the members an initial glimpse of the Hall of Science as well as a first opportunity to see the exposition at night.

The technical sessions began on the morning of this same day, some at the University of Chicago, some at McKinlock Campus of Northwestern University and some at downtown hotels. In an article of this length it is impossible to attempt even to list the many papers presented at these meetings; indeed, their mere listing involved a 144 page closely printed program. As implied before, the character of these papers were extremely diverse and many of them were far removed from the average interests of the engineer or physical scientist and others were so highly specialized or so abstruse that only a few could understand them. Consider, for example, such papers as these presented at the mathematical section: "Every large number is the sum of nine values of a cubic polynomial in X" and "A set of four postulates for Boolean Algebra in terms of the implicative operation." Clearly these papers are only for the relatively few specializing in certain specialized branches of mathematics. This, of course, is true of the other branches of science as well. The development of the sciences has been carried to a degree of refinement and specialization where only those who are actually concerned with their development are qualified to understand their modern ramifications. So, at these meetings, in many instances, only a handful, so to speak, of those present could intelligently discuss the papers.

This does not mean that such papers were not of general interest, for while the actual details of certain theories and processes may be too complex for the non-specialist to understand, the results which these theories or processes lead to are relatively simple and of great importance to the world at large. This was particularly true at these meetings with regard to developments in atomic theory.

The papers presented before the professional engineering societies in the second week were more practical, of course, and contained information and data on many new and interesting developments. These meetings, however, were not entirely concerned with mechanical and physical principles; they considered economics and human relations as well. At a number of joint meetings with the Econometric Society, the Engineering Societies considered fundamental problems of mutual interest to engineers and scientific economists.

One meeting of particular interest was the one held on Friday evening, June 30, where Dr. F. B. Jewett of the American Telephone and Telegraph Co. and A. P. M. Fleming of the Metropolitan Vickers Electrical Co. of Manchester, England, spoke. Dr. Jewett urged a greater attention to the scientific and engineering education of our youth, so that they in the future will better be able to cope with the problems of the machine which seem so difficult of solution today.

Mr. Fleming discussed internationalization of scientific knowledge as a factor in economic recovery. He has traveled much during the last few years in Russia and he discussed briefly the effect which scientific developments in Russia might have upon the rest of the world in years to come. "The Soviet government," said Mr. Fleming, "looks to science to play an important part in its industrial and economic activities. While their research, thus far, is to a large extent imitative, considerable progress has been made already and there is in the U. S. S. R. a larger body of organized research workers under unified control than exists in any other industrial country in the world. Whether the soviet plans succeed or fail, already enough has been accomplished to show the possibilities of this combined scientific effort. Even partial success may have far reaching

effects on the rest of the industrial world. Should the standard of living be raised to the same or to higher levels than those of other countries and, as may in time reasonably happen, there would be considerable labor unrest in other countries.

The idea that engineers are best fitted to take leadership in this changing and confused world partook of lively discussion at another joint meeting of the Econometric Society. Dean D. S. Kimball of Cornell University and C. F. Hirschfield questioned the view that engineers should be able to step into the field of economics and solve problems which have vexed some of the best brains in the world. Dr. Hirschfield maintained that economics was not yet a science and that, for the present at least, engineers should not be regarded even as questionable leaders. "Back of it all," he said, "lies that peculiar organism known as the human being It is his reaction to stimuli of various sorts that constitutes what I am sufficiently optimistic to believe will ultimately be the true science of economics."

On Wednesday evening, June 28, a joint dinner of all the engineering societies was held at the Stevens Hotel. Many of the societies had dinners of their own during the week but this was the one dinner at which they all met. At this dinner the gathering was addressed by two speakers, Dr. Karl Compton, president of Massachusetts Institute of Technology, and Edward J. Mehren, president of the Portland Cement Association. Dr. Compton spoke on the need for intelligent planning, a greater coördination of intellectual effort, basing his thesis upon the second law of thermodynamics. Research, he pointed out, is necessary for survival. Mr. Mehren discussed the contribution of the engineer to progress.

Many New Scientific Developments

At the joint sessions of the American Physical Society and the A.A.A.S. and at the general sessions of the latter, remarkable developments in the field of quantum mechanics and atomic disintegration were disclosed. The atom has long been impregnable, for centuries it has resisted all the resources of the alchemist and scientist. Within the last ten years, however, indeed, mostly within the last two years, it has begun to look as if the atom may succumb all along the battle front. The disintegration of the atom today is largely a question of accelerating charged or uncharged particles such as protons, neutrons, or alpha particles to such a high speed that they can enter or come close to the nucleus of the atom. This in turn resolves itself into a question of voltage and until quite recently the attainable voltages were entirely insufficient to cause the accelerations needed. With the development of new types of generators, such as the Van de Graaff 10,000,000 v. electrostatic generator,[1] sufficiently high speed particles can be obtained to effect disruption of the atom or transmutation of the elements.

Perhaps the most interesting experiments described at this meeting were those of Livingston, Henderson, Lewis and Lawrence of the University of California. Lawrence does not actually use or develop a very high voltage but he uses a moderate voltage to give a succession of pushes to the ions until they attain speeds equivalent to that given by 5,000,000 v. or more. With apparatus now available he expects to attain speeds equivalent to 25 million volts. Using this apparatus, they have bombarded various elements with protons ranging in energy from 600,000 to 1,600,000 v. and in every instance obtained evidence of disintegration. Lithium yielded alpha particles (i.e. helium) of 8.3 and 9.1 cm. ranges when bombarded by protons of 600,000 and 1,600,000 v. respectively.

Hydrogen Is an Isotope

Considerable discussion took place at these meetings regarding the new heavy isotope of hydrogen. The atomic weight of ordinary hydrogen is 1.008. The heavy isotope of this element which has been isolated recently has an atomic weight of 2. The nucleus of this atom has been named the deuton. Because of its weight, the deuton when accelerated to high speeds possesses great amounts of energy, hence it makes an excellent "projectile" in disintegration experiments. In one series of experiments described, eight targets were used and in every instance disintegration with the emission of alpha-particles was observed.

Other noted scientists working in this field who presented papers at these meetings were J. D. Cockroft and F. W. Aston, both of Cambridge, England; K. T. Bainbridge of the Bartol Research Foundation, M. A. Tuve of the Department of Terrestial Magnetism, Washington, and many others. All these investigations are coördinating their research by the constant interchange of data. Each know what the others are doing and with such an interchange of knowledge, the next few years should bring forth some really remarkable discoveries in this direction.

Another notable event of the convention was the general session of the A.A.A.S. at McKinlock Campus, Northwestern University, on Wednesday evening, June 21. Two speakers addressed this meeting, F. W. Aston of Cambridge, who presented The Story of Isotopes, and R. A. Millikan of the California Institute of Technology who discussed "New Light on Nuclear Physics." Dr. Millikan's paper was of especial interest since he presented new data on his cosmic ray measurements and in a series of beautiful new photographs showed new evidence of the existence of the positron, the newly discovered positive counterpart of the electron. His cosmic ray researches, made in airplanes flying at altitudes up to 29,000 ft., showed new proof of a selective distribution of cosmic ray energy values, which substantiated his contention that these rays are the result of the building up of heavy atoms from lighter ones.

Better Control Predicted

One encouraging feature of the meetings was the considerable interest in economics and human relations. The engineer and scientist by virtue of his mastery over things physical has been blamed for the world's ills, and pleas have been made for a cessation of industrial and technical development. The engineer knows that the trouble lies not with what he has done, but in the inability of economists, politicians and statesmen to use the product of his work to the best advantage of the human race. It is to this end that he is now beginning to direct his attention. His interest in these matters at these meetings, therefore, was extremely significant.

[1] Ten Million Volts, Direct Current—Power Plant Engineering, May 1933, page 216.

Mechanical Engineers Present Research Findings

FROM JUNE 26 TO 30, A.S.M.E. CONDUCTED 43 SESSIONS AND PRESENTED 127 PAPERS AND REPORTS AT SEMI-ANNUAL MEETING IN CHICAGO

WITH a record registration of nearly 1400 for the semi-annual meeting, the American Society of Mechanical Engineers spent an extremely busy week in Chicago. Nearly all divisions of the Society had papers to present which made many simultaneous sessions necessary. In all 127 papers and reports were presented mostly in abstract and discussion added considerably to the value of the papers. The 43 sessions held gave little time to members for outside interest.

Predominating among the papers presented which were of interest to power plant engineers were reports of scientific research dealing with power plant operation problems and equipment design. Tests of equipment, feedwater, fuels and smoke abatement were topics that also came in for consideration with comprehensive papers and thorough discussions.

As customary at the semi-annual meeting of the Society, the nominating committee made its report on nominations of officers of the Society for 1934. The election will be by letter ballot of the entire membership on September 26th. The nominees presented are: President, Paul Doty, president of the Minnesota State Board of Registration, St. Paul, Minn.; Vice-presidents, H. L. Doolittle, designing engineer, Southern California Edison Co., Los Angeles, Cal.; Wm. L. Batt, president, S.K.F. Industries, New York, N. Y.; Ely C. Hutchinson, president, Edge Moor Iron Co., Edge Moor, Del., and Elliott H. Whitlock, Cleveland, Ohio; managers, James M. Dodd, consulting engineer, New Orleans, La.; Ernest L. Ohle, professor mechanical engineering, Washington University, St. Louis, Mo., and James A. Hall, professor mechanical engineering, Brown University, Providence, R. I.

FIRING FUEL OIL AND PULVERIZED COAL

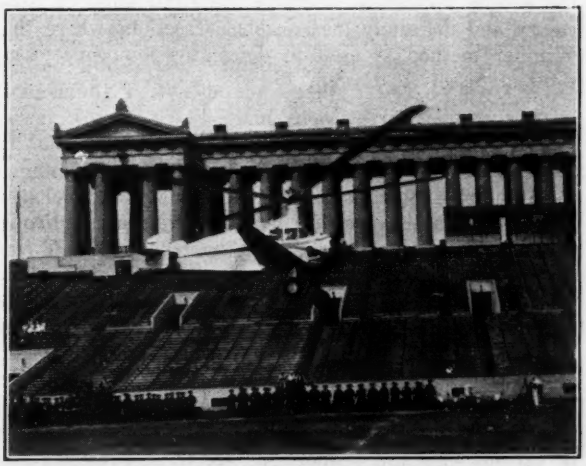
Availability of fuel oil during the past few years at prices below the corresponding heat-unit price level of coal has resulted in the changing of a large number of steam generating plants from coal to oil firing, according to James F. Muir of the Montaup Electric Co. in his paper entitled Oil Firing in Pulverized-Coal Furnaces. Through the foresight of the designers, a few plants which were built before the commercial development of combination burners were provided with furnaces suitable for either coal or oil burning.

Firing of oil in pulverized-coal burning furnaces equipped with horizontal cylindrical type coal burners presents a relatively simple and low cost undertaking. On the other hand, intertube type and fan-tail burner installations give rise to economic as well as engineering problems in avoiding the dismantling of expensive coal burner equipment and costly changes in water cooled walls.

Excessive plugging of preheaters with oil firing has been encountered in a number of plants. Plugging and corrosion of preheaters will occur in any plant with gas outlet temperatures as high as 325 to 350 deg. F. and using fuel oil having a sulphur and hydrogen content in excess of 2 per cent and 11 per cent respectively. Decrease in superheat temperature takes place in almost all cases of conversion of pulverized-coal furnaces to oil firing. To a large extent, this is due to the lower percentage of excess air required for oil firing.

BOILER WATER STUDIES

Professor Frederick G. Straub of the University of Illinois presented a paper entitled Study of Calcium-Sulphate Scale Prevention, as the results of extensive



AUTOGIRO OF JUAN DE LA CIERVA CARRYING JAMES G. GAY, PILOT AND HAROLD T. PITCAIRN, LANDING IN SOLDIER FIELD ON ENGINEER'S DAY AT A CENTURY OF PROGRESS EXPOSITION—THE CHICAGO WORLD'S FAIR. CIERVA WAS PRESENTED WITH THE GUGGENHEIM MEDAL

research carried on during recent years. The results obtained may be briefly summarized as follows:

Calcium-sulphate scale forms at a constant rate at 150, 250 and 500 lb. pressure, practically independent of the rate at which the calcium sulphate is being added to the boiler and the solubility of the calcium sulphate. Above 500 lb. the rate of scale formation becomes lower. At 1000 lb. the rate of calcium-sulphate scale formation is about one-third as fast as at 500 lb. At 2000 lb. it appears to be less than 10 per cent of that at 500 lb. with a constant rate of heat transfer. The amount of undecomposed sodium carbonate necessary to prevent calcium-sulphate scale formation at pressures up to 2000 lb. is less than 30 parts per million. This indicates that it is practical in many plants to do condi-

tioning with soda ash or its equivalent at high pressures.

C. W. Foulk, chairman of the Joint Research Committee on Boiler Feedwater Studies, presented a progress report entitled Effect of Suspended Solids in which he described the experimental work being carried on by the committee and reported the following facts about the behavior of the solids studied.

1. One substance, the ground flint, had no foam-promoting effect at any pressure, even atmospheric. 2. All of the foam-promoting substances tried lost their effect rapidly in the salt solution at the high temperature of the boiler; 3. The temperature coefficient of this loss of foam-promoting property is a high one. Some substances which lost their effect only after 10 hr. boiling at atmospheric pressure, lost it completely in 10 to 15 min. at the higher temperature of 150 lb. pressure; 4. Those foam-promoting substances which had lost their effect then behaved like the ground flint, that is, they lowered the foaming slightly by inducing greater smoothness of boiling.

Determination of Dissolved Oxygen in Feedwater was made the subject of a paper presented by S. J. Meisenburg of the University of Michigan, and C. H. Fellows of the Detroit Edison Co. This paper took the form of a progress report comparing the accuracy of several methods of determining the dissolved oxygen in feedwater and although this work was just begun the results appear to point to the application of necessary and definitely measurable corrections where the Winkler method is used to determine low concentrations of dissolved oxygen.

Studies in Smoke Abatement, Cinder and Fly-Ash Removal

Arthur C. Stern, Stevens Institute of Technology, reported in his paper entitled Measurement of Properties of Cinders and Fly-Ash, the results of a 2 yr. study of available measurement methods for cinders and fly-ash. The measurement methods investigated included filtration through cotton, woolen and asbestos bags of various sizes and shapes, through paper and alundum thimbles, through beds of granulated and pulverized sugar of various depths, and through asbestos wool, also centrifugal separation in cyclone collectors of various sizes and proportions, electrical precipitation in precipitators of various dimensions using various potentials and the Greenburg and Smith type of impinger.

The results obtained in a coöperative investigation at the Engineering Experiment Station of the University of Illinois with the Utilities Research Commission, Inc., on the problem of the elimination of sulphur compounds from boiler-furnace gases were reported by H. F. Johnstone of the University of Illinois. In this paper he described the types of gas washers and compared them from the standpoint of application to the large quantity of gas emitted from power station boilers. It was shown that the possibility of economically washing these gases with untreated water is very remote. The limits imposed by the solubility of sulphur dioxide are those of the quantity of water required and the time and surface of contact needed. A comprehensive study has been made of the catalytic oxidation method for removing the sulphur dioxide. The results indicate the limitations to the method.

Several salts of ammonia have been found to have a high capacity, absorbing and liberating as much as 6 per cent by weight of sulphur dioxide when used for washing flue gases. The method is attractive both from the mechanical and economical viewpoint, since the by-product sulphur dioxide, which is produced in the pure state, has a considerable market. Complete details of this process are being worked out.

Operation Problems and Test Results

Under the heading of Standby and Reserve in a Pulverized-Fuel Plant, E. H. Tenney of the Union Electric Light and Power Co., St. Louis, Mo., presented an extremely interesting operating problem which frequently confronts engineers in central stations. The desirability of uninterrupted service has necessitated running spare equipment in central stations so that units or plants can pick up the load which may be lost in another part of the system. When trouble does develop and the load of one plant is thrown on to another almost instantaneously, the operator, particularly in a steam plant, encounters one of the most difficult problems of operation he is called upon to meet. The problem of immediate reserve (as contrasted to the type of cold standby to be available only on notice) can be divided into the several phases in which a sudden load increase affects plant performance: (1) The rapidity and extent to which turbines pick up load in response to a system fault and the drop in frequency incident thereto; (2) the rate at which greater turbine load results in demand for greater steam plant output; (3) the result on boilers and boiler steam pressure as the increase in steam demand reaches the boiler room; and (4) the rate at which fuel burning can be stepped up to meet the demand for steam and so avert excessive drop in steam pressure. In the final analysis the ability of a plant to pick up load depends on the boiler room.

Results of tests of two 101,000 sq. ft. surface condensers in the Hudson Ave. station of the Brooklyn Edison Co. were summarized by J. N. Landis, Mechanical Engineer of the Brooklyn Edison Co., and the design features were briefly described. These tests are of particular interest because of the size of the units and the difference in the design, one being a Worthington and the other an Ingersoll-Rand. The tests were unusual in that they determined the cleanliness ratio of the condensing surface. The manner of making the cleanliness-ratio measurements has already been discussed in detail before the A.S.M.E. by Hardy and Cooper. The author confined his paper to reporting of test facts and left to others the making of comparisons. The test results are believed to show fairly the performance of two modern condensing units under as closely parallel conditions as it is practical to secure.

Prompted by the efforts of steam-power engineers to lower plant heat rates, G. A. Hendrickson and S. T. Vesselowsky, of the Detroit Edison Co., have made an intensive study of the relative efficiencies of available power cycles, which in turn has brought forth a number of valuable papers on both the thermal and economic factors of the problem. They presented their findings in a paper entitled, Study of Available Steam-Power-Plant Heat Cycles. The response of the Detroit Edison Co. to this situation was planned to supply both

operating experience and a theoretical survey. Thermal results were presented in a form readily adaptable to the needs of those making economic comparisons. Two complete sets of heat rates were given: namely, plant heat rates for estimating the rate of use of fuel, and turbine heat rates with supplementary data for estimating the size of the various equipment in a plant. The cycles studied include Rankine, regenerative-feedheating, reheating regenerative-feedheating, and a cycle using regenerative preheat of the combustion air by bled steam. The initial steam conditions covered include temperatures of 700 to 1000 deg. F. and pressures of 200 to 3500 lb. per sq. in. With each cycle and temperature the initial pressure was restricted to a value giving the maximum permissible moisture content of the exhaust.

Million Pound Boilers

W. E. Caldwell, research engineer of the United Electric Light and Power Co. of New York, reported the tests on the large Hell-Gate direct-fired boiler units. Among the outstanding features which characterize this boiler installation is the capacity of each of the two units in excess of 1,000,000 lb. per hr. and the direct-fired, slag-tapped furnace with a twin arrangement of sectional header boilers above a single furnace. The boiler has been operated for sustained periods at outputs as low as 200,000 lb. per hr. and as high as 1,080,000 lb. per hr. Various methods of changing the rating on the boilers have been used to minimize time lag in effecting changes and to determine the source of lag. The shortest lag was obtained by giving considerable overtravel to the coal feeders and adjusting the secondary air supply to follow the change in coal supply instead of following the steam flow. Efficiencies obtained from the steam generating unit range from 78.3 and an evaporation of 1,078,000 to 88.7 with an evaporation of 402,700 lb.

In presenting a paper Underfeed Combustion and Effects of Preheated Air P. Nicholls and M. G. Eilers, described investigations carried out by the Bureau of Mines on a small experimental furnace. Fuel, air supply and preheat were investigated, one of the reported results being that an increase of from 80 to 300 deg. F. increased the rate of ignition and possible maximum rate of burning of Illinois coal 97 per cent.

Piping Design

Presented as a manual of piping design, E. A. Wert, S. Smith and E. T. Cope, all of The Detroit Edison Co., give the results of a long series of investigations under the title, Design Method for Flexible Piping Members. In this paper, the mathematical analysis necessary to be carried out in determining the deflection and reaction characteristics of the ideal pipe has been developed to such a state that it is a dependable tool. It is, however, rather involved and requires the consumption of considerable time in its application. Resort was made therefore to the use of the graphs and tables of constants. The mathematical basis for each graph was explained briefly.

Of considerable interest were the sessions on hydraulics and water power development, held jointly between the A.S.M.E. and the A.S.C.E. Most important from a technical point of view perhaps were the two sessions on Water Hammer. It has been recognized for some time that many valuable contributions to technical literature have been made on this subject but that many of the phases of this problem has not been covered adequately in the English language. A committee was therefore appointed to review the existing theory on water hammer with a view to summarizing this theory, comparing the various methods employed, considering actual water hammer problems and determining which theories apply and which theories have been confirmed by actual experimentation. The result of this study was this symposium on water hammer presented at this meeting. The report of the committee is incorporated in a 90 page booklet, privately published under the auspices of the Water Hammer Committee of the Hydraulic Division of the A.S.M.E. This report undoubtedly contains the most complete and up-to-date information and data on water hammer ever published.

St. Lawrence Development

The joint session devoted to a résumé of the engineering reports on the St. Lawrence Power Development by Daniel Mead and Thos. Hogg on Thursday afternoon was animated by a bitter fight over the merits of the respective plans. The conflict began with Professor Mead's presentation of his paper in which he stated that the ratification of the treaty now before the senate would be a serious mistake—a misfortune for both United States and Canada. Following the presentation, Frank P. Walsh, chairman of the New York state power authority, who had come to Chicago especially to reply, raised the charge of power company propaganda. He charged that the Mead report was loaded with omissions and misleading statements, that it contained unwarranted slurs on former President Hoover and invited the societies to repudiate the author for "attempting to utilize the societies for dissemination of propaganda." Walsh then read a telegram from Senator La Follette from Washington who claimed that Professor Mead had always been a hard-shelled reactionary during his years as a member of the faculty of the University of Wisconsin and that he was an agent of the power trust.

Engineering Not Entire Story

In his reply to these charges Professor Mead said "My services have been for sale for fifty years but my opinions never. If any of you here, as engineers, can detect signs of propaganda in my report, I myself will head a committee to move for my expulsion from all three of the societies to which I belong."

A wholly different reaction to Professor Mead's paper was offered by Mr. Hogg, the Ontario hydro-electric engineer. "Such a question as the St. Lawrence treaty cannot be stilled satisfactorily on engineering and economic grounds alone," he said. "With the international boundary involved, there are national, state and provincial interests that must be given consideration." He then went on to discuss the question of safeguarding the Canadian towns from floods, winter ice jams, etc. He differed with Professor Mead's interpretation of costs, saying the accepted Crysler Island plan would cost no more than the others.

Electrical Engineers Discuss New Developments

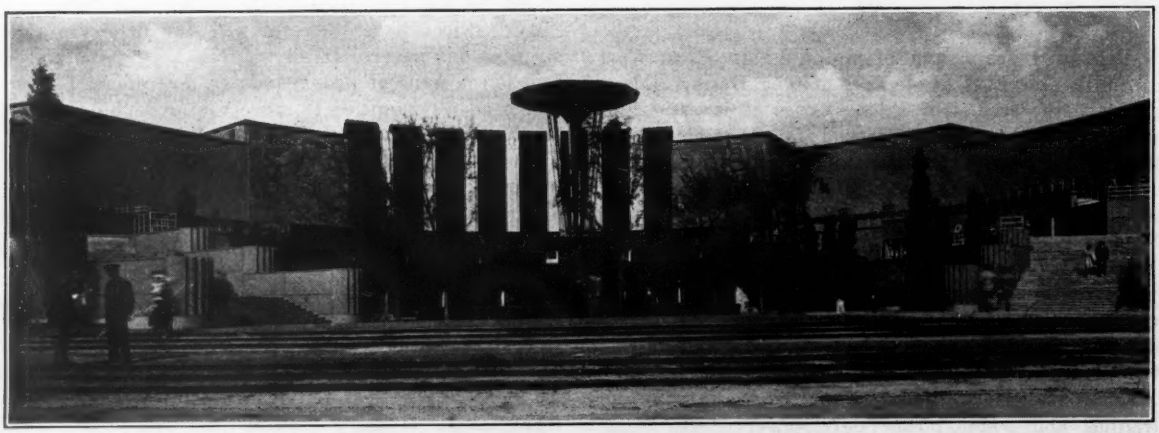
OF THE MANY engineering meetings held at Chicago during Engineers' Week, the two of outstanding interest to electrical engineers were those of the American Institute of Electrical Engineers at the Edgewater Beach Hotel and the Institute of Radio Engineers at the Hotel Sherman. Both of these meetings provided material of intense interest for electrical men regardless of their particular fields, indeed it was unfortunate that they were held at the same time for their simultaneity prevented many engineers from attending sessions in which they were interested. In this respect, however, the I. R. E. showed better judgment than did some of the other engineering societies for the I. R. E. had no simultaneous sessions of its own. It was annoying enough to have so many different societies meet at one time without making matters worse by simultaneous sessions within the individual organizations.

Although the A. I. E. E. Convention opened officially on Monday morning, June 26, the program for this day was of a general nature and consisted of the annual business meeting, the presentation of prizes and medals and the president's address. Monday afternoon was devoted to a conference of officers, delegates and members, but no technical sessions were held until Tuesday morning, when two sessions were held, one on protective devices and the other on instruments and measurements.

The fact that there were no technical meetings at the A. I. E. E. on Monday gave those members of the A. I. E. E. interested in radio developments to attend the meetings of the Institute of Radio Engineering on Monday. A number of exceedingly interesting papers was presented at these sessions, some of which had application outside the purely radio field. One of these, for example, was the paper by Leonard Garver, Jr., on patent relations of the engineer to his employer. Mr. Garver pointed out that three different situations are involved; first, where the employee conceives the idea and develops it on the time of the employer, using his laboratory. Second, where the employee conceives the idea but develops it on his own time, using his own personal apparatus. Third, where the employee conceives the idea either on his own time or during his hours of employment but develops it on his own time, however, using his employer's apparatus. All these involve different rights and, therefore, different provisions should be made in each class if good feeling is to prevail between the employer and the engineer.

Among the purely technical papers presented at the Monday session of the I. R. E. the one of greatest general interest to electrical engineers as a whole was the one by V. K. Zworykin, describing the Iconoscope. This is a new version of the photocell—the electric eye, developed as a pick up device for television but which opens up wide possibilities for application in many fields as an electric eye, which is sensitive not only to the visible spectrum but also to the infra-red and ultra-violet region. It involves the use of a cathode ray used as an inertionless commutator, a principle that may have important applications in other fields. For use in television systems it for the first time permits of a television system without a single mechanical moving part. Its development will be regarded with great interest by electrical engineers generally. It required ten years to bring the original idea to its present state of perfection.

At the Edgewater Beach Hotel on Tuesday morning the A. I. E. E. opened its technical program with two series of papers, one on protective devices and the other on instruments and measurements. The former included papers on The Testing of High Speed Distance Relays, The Relaying of High Voltage Interconnection Transmission Lines, Tests on Circuit Breakers, A Com-



THE ELECTRICAL BUILDING AND THE ILLUMINATED FOUNTAIN AT THE CENTURY OF PROGRESS IN CHICAGO

pression Type Low Voltage Air Circuit Breaker and a subcommittee report on lightning arrester performance. The discussion of the low voltage air circuit breaker was of considerable interest for it showed the possibilities of the air circuit breaker when designed properly. The breakers shown had interrupting capacities of 5000 amperes at 250 v. and will form part of a new line of breakers up to 600 ampere carrying capacity with interrupting capacities as high as 10,000 amperes.

The paper on better instrument springs by Robert W. Carson was an excellent example of how detailed study of comparatively trivial matters affect great improvements in the design of electrical equipment. Instrument springs seem a relatively unimportant item in instrument construction, but careful study of the subject shows that the accuracy of electrical measuring instruments depends as much on the quality of the control springs as on the design of the torque producing elements. Unstable effects found in the application of spiral springs in electrical instruments arise from aging in service and hereditary hysteresis in the spring material. In Mr. Carson's paper, he showed that moderate heat treatment has an important effect on hereditary hysteresis, that the softening range of cold worked spring ribbon is very critical, that the forming temperature and forming time have a controlling effect on residual stresses and that a stress relief anneal reduces aging and hereditary hysteresis. Hereditary hysteresis is a time lag of the deflection in relation to the applied torque.

There were no technical sessions at any of the engineering societies on Wednesday because of Engineers' Day at A Century of Progress, but on Thursday, the A. I. E. E. had two morning sessions, one on Power Transmission and Distribution and the other on Communication and Power Generation.

At the latter session G. G. Post, vice president of the Milwaukee Electric Railway and Light Co., presented the Design Features of the Port Washington Power Plant. The initial section of this station will have a capacity of 80,000 kw. and will utilize 1230 lb. steam pressure and 825 deg. F. steam temperature at the throttle. This paper provoked considerable discussion as a number of those present differed as to the design principles, though most of them admitted that if the operating results are in accordance with predictions, the design will be justified. Mr. Engles of the Boston Edison, for example, pointed out that this station is one of the very few stations using the lazy flame, low heat release burners. Their own studies, he pointed out, indicated that high heat release furnaces are cheaper. Also, he differed with Mr. Post's estimate of a 2.1 per cent saving in economy, due to the use of the bin system of pulverized coal against the unit system. He said he did not believe it.

Professor Christie also commented upon the use of the bin system, pointing out that it was contrary to usual practice. He also thought that a still higher temperature could have been justified. Twenty-five or 50 deg. higher, he said, would not have cost much more as regards material but would have resulted in higher economy.

Of interest to hydroelectric engineers at this session was the paper by W. S. Lee on the Beauharnois Development on the St. Lawrence River. This plant when completed will be the largest in the world. It is comparatively simple in its design and engineering features but is unique that after the first section (now completed) is installed, the canal section will be enlarged to its full size by means of power generated by the first section of the plant itself.

The general subject of Power Transmission and Distribution was treated in a session also on Thursday morning. Here two papers were devoted to the protection of transmission lines by protective gaps. One of these, "The Expulsion Protective Gap," by McEachron, Gross and Melvin, showed General Electric Co. developments in this field, and another, "The Deion Flashover Protector," by Opsahl and Torak, presented those of the Westinghouse Electric & Mfg. Co. These devices are meeting with considerable favor and the American Gas and Electric Company is installing them on the 65 mile 125 kv. line from Roanoke to Glen Lyn.

The remaining four papers at this session were all on the subject of cable dielectrics. In a paper by Dr. J. B. Whitehead on the life of impregnated paper, he showed that the origin or basic chemical structure of the oil has an important bearing on the life of impregnated paper. Other factors enter into the picture but there is still a large amount of data to be analyzed and correlated in this respect.

Much interest was displayed in a new method for the rapid and accurate determination of power factor and hydrophil determination for total oxidation products as set forth in a paper by Wyatt, Spring and Fellows of the Research Department of the Detroit Edison Co.

The technical program closed Friday morning with two sessions, one on Electrical Machinery and Welding and one on Electrophysics. The latter were all of a practical nature and ranged from questions involving the regulation and short circuit characteristics of transformers to the effect of radiation from electrically heated walls upon comfort conditions. A paper on this subject was presented by L. S. Shad of the Westinghouse Electric and Manufacturing Co. This paper created quite a bit of discussion. Messrs. Teare and Levine of Schenectady were doubtful of Mr. Shad's comfort criteria and asserted that the higher the air temperature, the lower the wall temperature required to establish the balance between radiation, conduction and connection known as the comfort zone.

Other papers at this session discussed potential distribution in a. c. arcs and the effect of polarity on electric impulse sparkover.

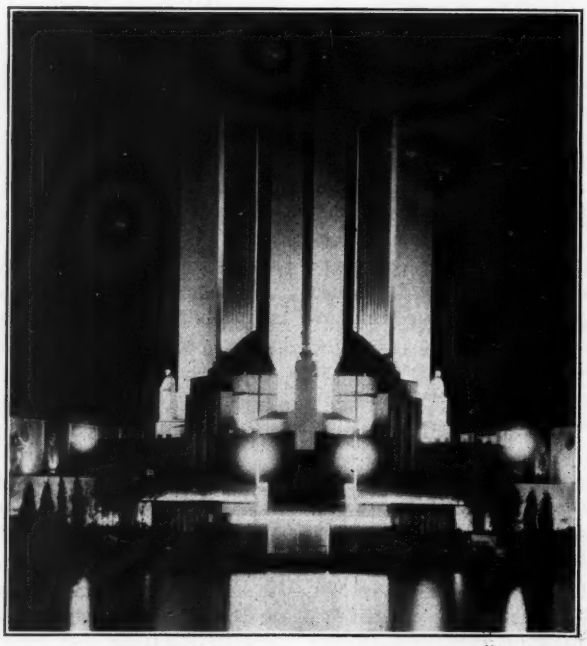
At the election of officers, Dr. John B. Whitehead, dean of the faculty of engineering, Johns Hopkins University, was elected president. Other officers elected were as follows: Vice presidents, A. M. Wilson, Cincinnati, O.; F. M. Craft, Atlanta, Ga.; R. B. Bonney, Denver, Colo.; R. W. Sorenson, Pasadena, Cal.; A. H. Hull, Toronto, Canada; directors, P. B. Juhnke, Chicago; Everett S. Lee, Schenectady, N. Y.; L. W. W. Morrow, New York, N. Y.; treasurer, W. I. Slichter, New York, N. Y.

The annual report of the Board of Directors presented at the meeting showed a total membership on April 30, of 17,019.

Testing, Heating and Refrigerating Engineers Present Papers at Chicago Meetings

FACED WITH numerous committee reports dealing with research investigations, an unusual number of standardization projects due to the appearance this year of the triennial Book of Standards, coöperation and joint sessions with other societies and a full appreciation of the extra time demands of the World's Fair, the American Society for Testing Materials did remarkably well in arranging a 14 session program June 26-30 at the Stevens Hotel.

The convention opened with a joint meeting with the American Foundrymen's Association, the third of a series of joint meetings arranged to provide the engineering profession with authoritative data in concise form on the properties of gray iron castings produced by the best present methods of production. On the first evening the Charles B. Dudley Medal was presented to Samuel Epstein, metallurgist of Battelle Memorial Institute, and the election of new officers was announced, this short portion of the program being followed by an informal smoker. T. R. Lawson, head of the department of civil engineering at Rensselaer Polytechnic Institute, Troy, N. Y., was elected president for the ensuing year and Hermann von Schrenk, consulting timber engineer of St. Louis, Mo., was elected vice-president for a 2 yr. term. The Dudley Medal is awarded annually to the author of the paper, presented at the preceding annual meeting, which is of outstanding merit and constitutes an original contribution to research in engineering materials. The paper presented in 1932 was entitled A Study of the Embrittlement of Hot Galvanized Structural Steel.



THE FEDERAL BUILDING AT NIGHT

On the afternoon of the second day, Dr. H. J. Gough, superintendent of the engineering department, National Physical Laboratory, England, delivered the Edgar Marburg Lecture on the subject, Crystalline Structure in Relation to Failure of Metals Especially by Fatigue. The Marburg Lecture is an annual event delivered by an eminent authority in the field of metallurgical research and Dr. Gough, who has won world renown for his work on the strength of single crystals of metals, is the first scientist from abroad to deliver a Marburg Lecture. The entire third day of the convention was devoted to the Engineering Day program and the afternoon and evening of the last day to joint sessions with the Econometric Society.

Outside of these few activities the scheduled time was devoted to papers and committee reports covering ferrous and nonferrous metals, coal, paints, petroleum, concrete and cement, several of the latter dealing with interesting phases of the research work carried on in connection with Hoover Dam.

Those reports of more immediate interest to our field dealt largely with corrosion, creep, effect of high temperature on metals, coal and particle size determination. Proposed tentative short time and long time high temperature tension test methods were proposed by the joint research committee with the understanding that as yet short time creep test results have not been correlated with the phenomenon of slow creep at high temperature, although it is hoped that further research will accomplish this. Investigation of creep by means of a modified Rohn test was also reported by C. R. Austin and J. R. Gier, both of Westinghouse Elec. & Mfg. Co. This is a test in which the test specimen under constant load acts as a dilatation thermometer to regulate the temperature of the furnace. The authors hope to give comparative data on elementary metals in a subsequent paper, the data at present being largely limited to that necessary to determine the operation of the equipment.

Work on classification of coals is proceeding and it is hoped that the work of the scientific classification subcommittee will be available for the fall committee meetings so that a tentative scheme will be available for the 1934 annual meeting. A tentative classification of North America coals according to rank and type has been made

and a new subcommittee is now making a special study of disputed boundary lines between the classes, recommending definite criteria for each class and assigning names.

Need for standardization of methods of particle size analysis and presentations were discussed by E. J. Dunn, Jr., of the National Lead Co. and John Shaw of Columbia University. The importance of fineness in scientific and industrial fields has led to a diversity of research and various techniques of sizing which are different if not impossible to correlate. These methods are reviewed and the conclusions reached that no single function can be used to describe all types; thus the result of the investigation like those of short time creep may be considered negative.

Dye Tests Limited in Use

Another investigation to determine the surface of pulverized coal by means of the amount of dye absorbed was reported by R. A. Sherman, C. E. Irion and E. J. Rogers, all of the Battelle Memorial Institute. The literature shows that the pH value of the solution, the composition and structure of the dye and the concentration of the dye are important factors. Preliminary experiments showed that methylene blue medicinal was a suitable dye that was absorbed by coal, although the attainment of equilibrium was slow.

Adsorption measurements were made on 11 sized samples ranging from No. 8 to No. 200 of each of three coals. With the total area of the coal plotted against the total dye adsorbed a separate curve results for each coal. The results do follow Freybdlich's isotherm, but while the results of two coals plot as straight lines the third coal does not follow the same equation for the smaller sizes. As the dye adsorbed per unit of surface was not the same for different coals, the practicability of the application of the method for the determination of surface in grindability studies is doubtful, although the method has interesting possibilities for the studying characteristics of different coal beds.

National District Heating Association

With businesslike dispatch the National District Heating Association proceeded with its twenty-fourth annual convention, held June 27 to 30 at the Palmer House, in spite of the warm weather and distractions of the Fair. The breakfast sessions of this organization, although interfering somewhat with the serious business of eating, could be copied to advantage by other organizations. Not only do they help get members out early, insuring prompt attendance at regular sessions, but they help relieve the pressure of committee work in other meetings and, being more informal and intimate, evoke free discussion.

Many interesting papers and reports were presented, ranging from rates to the traditional manufacturers' round table. Of the many committee activities the reports and papers of the Distribution and Station Engineering committees were particularly interesting from an engineering standpoint. From the records of 42 companies reporting to the Operating Statistics committee it appears that there has been a decrease of about 3 per cent in the number of customers, although the Eastern District is apparently forging ahead in spite of the depression and shows an increase of about 12½ per cent in connected load as compared with slight gains or losses in other districts. Revenue per thousand pounds of steam varies from 53.6 to 129.4 cents, the average revenue having decreased 2.8 cents or 3.2 per cent from the 1931 level. In the case of small cities there appears to be a downward price trend, although four companies reported definite increases in the unit price of steam.

Various types of rate structures such as the straight line, block and Hopkinson were analyzed by the Rates and Regulations Committee and presented in graphical form in order to facilitate study of published rate figures and the effect of capacity factor and demand charges. A summary of some of the data from a questionnaire sent out by this company shows the diverse nature of this comparatively new industry.

Thirty-eight companies reporting distributed live steam, while twenty companies supplied exhaust steam. Twenty-two companies supplied only live steam service; four companies supply only exhaust steam service, while sixteen companies supplied both live and exhaust steam. Twenty-five companies operate systems at high pressure (above 35 lb. ga.), thirty-three companies operate systems at low pressure (below 30 lb. ga.), fifteen companies operating both high and low pressure steam systems. Steam pressures reported range from 2 to 250 lb. The forty-two companies reported combined steam sales for the calendar year 1932 of 28,179,579,000 lb. The smallest companies reported an annual steam sales of 34,000,000 lb. while the largest company reported sales in excess of 11,000,000,000 lb. during the year.

By-Product Power

Twenty-four companies reporting stated that their practice is to generate electricity at the steam plants in conjunction with supply of steam service. Eighteen companies have no electric generating equipment whatever. Some of these companies generate electricity only for their own steam plant power and lighting uses, while others generate in excess of steam plant uses, delivering the excess current directly to the electric system of their affiliate company. Electric generation capacity installed in twenty-six plants reporting is 260,175 kw. or kv-a, the amount of electricity generated in these plants during the calendar year 1932 being 368,375,951 kw-hr. gross, the sum of the maximum electric loads on all generating equipment during the year being 139,345 kw. Assuming an average allowance of one cent per kilowatt-hour for all electricity produced, this by-product electric generation would provide approximately $3,700,000 annual credit to operating expenses.

This matter of by-product generation was discussed in detail by M. W. Benjamin and R. G. Felger, both of The Detroit Edison Co. The paper presented eight hypothetical schemes on a comparative basis to show what could be accomplished in the way of by-product generation by the use of different initial steam pressures and special heat cycles. All cases resulted in the same conclusions, that, on the basis of fuel savings only it is difficult to justify the investment required for by-product generating equipment if such equipment duplicates generating equipment installed in the

electric stations. To be really profitable the heating plant equipment must actually be able to assume a proportionate share of the system electrical peak and take the place of equipment there.

Long Distance Pipe Lines

Closely allied with this problem is long distance high pressure transmission when the steam is sold to an industrial company for the generation of power and for process use. Such a case was presented by P. F. Helm of the Indianapolis Power & Light Co. which sells steam for this purpose to Eli Lilly Co. From the Kentucky Ave. Station 250 lb. ga. 600 lb. steam is supplied to a line 5400 ft. long with an underground section consisting of 2613 ft. of 16 in. pipe and 2631 ft. of 10 in. pipe, the contract conditions at the end being 175 lb. ga. with not less than 100 deg. F. superheat. The ultimate capacity of the line is 200,000 lb. per hr. for the 16 in. section and 90,000 lb. per hr. for the 10 in. section. The performance of the line during its year of service has been satisfactory both from a transmission and radiation standpoint. Insulation efficiency expressed in per cent of bare pipe loss in still air and 50 deg. F ground temperature equals 94.97 for the 16 in. and 93.13 for the 10 in. sections. In many districts soil heating due to such underground lines becomes important, and W. A. Hess of the Philadelphia Electric Co. gave in graphical form results of tests to determine the temperature variations and characteristics. Further data on distribution system construction was presented by A. J. Slade of the American District Steam Co., who gave a detailed description of the new government system now under construction in Washington, D. C., to be supplied from the new boiler plant on C Street, S. W.

Line-Loss and Maintenance

Reports from 16 companies gave detailed data on line losses, a substantial number showing line losses per square foot per hour of operation in a downward trend as compared with previous years. The spread between companies is considerable however, making conclusions based on averages impossible. For instance the lowest company reported a loss of only 0.044 lb. per sq. ft. of radiation per hour as compared with 0.425 lb. for the highest. Individually these losses can be justified by differences in load factor, send out per thousand feet of radiation and other operating details.

These operating and maintenance details were covered in a comprehensive report by a sub-committee of the Distribution Committee. Following the report of a questionnaire showing frequency and methods of inspection G. D. Winans reported in detail the methods pursued by the Detroit Edison Co. In this system about 70 per cent of the mains are out of service during the summer months, the other 30 per cent are in service for customers using steam for water heating, process and cooking.

One of the important accomplishments of the meter and accessories committee was the formulation of a code covering flow meters giving uniform specifications and setting forth the limiting accuracy and factors affecting flow meters. One of the reports of this committee with costs of testing and maintenance per meter per year shows a range of from $27.00 down to $2.15 per year. This wide variation makes conparison difficult without examining individual and detailed reports. Many factors, such as size of company, number of meters, labor, routine and location, have a bearing on this item and must be given due consideration.

Space does not permit a detailed review of the many other papers presented. H. F. Johnstone, University of Illinois, brought up to date his work on the removal of SO_2 from flue gases and S. T. Powell, consulting engineer of Baltimore, outlined the determining factors in feedwater treatment for plants using large quantities of makeup. Charles O'Neill, of Peale, Peacock & Kerr, Inc., reviewed the relation of coal industry and the railroads and came to the conclusion that coal rates must be reduced, while J. R. McCausland, Philadelphia Elec. Co., reviewed recent developments in fuel burning equipment of the larger central stations. The competitive fuel field was reviewed by G. A. Orrok, Jr., The Edison Electric Illuminating Co., and the conclusion drawn that to best meet changing conditions furnaces for handling the various fuels interchangeably are the best solution.

American Society of Refrigerating Engineers

Meeting at the Sherman Hotel, June 26 to 28, the Twentieth Western Meeting of the American Society of Refrigerating Engineers consisted of three well balanced and not too long technical sessions grouped on the first two days, the third day being devoted to the Engineers' Day coöperative program. Perhaps the well cooled and comfortable meeting halls available for this society, and the Institute of Radio Engineers who also met at the Sherman Hotel, was partially responsible for the lively meetings. Certainly it was these two societies that were the only ones enjoying comfortable temperature during the week of unduly warm weather.

Quite in keeping with the temperature was a session on air conditioning particularly as applied to domestic conditions. Results of investigations on the Research Residence at the University of Illinois were presented in detail by A. C. Willard and A. P. Kratz, both from the University. Self contained room cooler were discussed by C. R. Neeson of Baldwin-Southwark Corp. and the Aerodynamics of Air Conditioning by S. M. Anderson of B. F. Sturtevant Co. Of more general interest was a paper by W. R. Woolrich, P. W. Scates and M. Tucker of the University of Tennessee. This paper presented the results of investigations to determine the effects of humidity, at temperatures below and above the freeing point, on the heat transfer of dry type, floor mounted, unit coolers. Results are too detailed to summarize but in general the unit heat transfer coefficient increases with the relative humidity for a given temperature. For a given relative humidity, the unit heat transfer decreases to a minimum and then increases with a rise in temperature, the low point ranging from perhaps 33 deg. F. for 85 per cent relative humidity to 40 or 41 deg. F. for 60 per cent relative humidity.

One session was devoted to thermodynamics and thermal problems covering absorbtion, SO_2, CO_2 refrigeration and windows, the latter in relation to air conditioning. From an engineering standpoint the session on current problems was most interesting, the

first paper by H. C. Guild of A. M. Byers, Inc., traced the evolution of condenser design up to the present modified tube type using wrought iron tubes and headers (see Power Plant Engineering, page 130, March 1933 issue, Ammonia Condenser of New Design).

Natural Gas

Another paper of current interest by C. T. Baker, consulting engineer of Atlanta, brought together data on three natural gas engine driven ice plants in Georgia. The natural gas engine has contributed help in lowering the cost of production per unit, as well as lowering the cost of producing electric power. Recent years have seen a decided increase in natural gas distribution from all of the gas producing fields and as natural gas is now available at attractive prices in many sections of the country, there has been an increase in the use of the gas engine as a prime mover in ice and cold storage plants, as well as in municipal and privately owned electric power stations in localities where gas is available. Contrary to some statements, engines using natural gas are not of recent development or lacking a background of respectability. Quite the opposite is the case. Proof of this is found in the voluminous bibliography of gas engine power which also records that such prime movers are economical and reliable, and that their mortality rate compares favorably with other types of prime movers.

Correlation of flow data and the prediction of pressure loss in pipe lines were presented by H. J. Macintire and G. Edwards of the University of Illinois. After a mathematical treatment of the fundamental laws, methods for predicting friction losses for any fluid based upon experimental results of a test with another fluid were given in considerable detail, two sample calculations being given, one determining the pressure loss with water flowing from results of steam tests, the other predicting air flow pressure losses from water flow tests.

Brewing Process

Because of present conditions perhaps the paper of widest interest was that presented by Dr. L. Nathan of Zurich, Switzerland, in which he described a modern system of beer production using the Nathan process. This system which accomplishes in 12 days what requires 3 mo. in older breweries requires no change from the conventional brewhouse. The wort is, however, cooled under complete air control so as to be absolutely sterile, fermentation later taking place in special fermentation vats in which the entire beer making process takes place, the finished beer passing directly from the fermenting tanks to the barrels. The aluminum fermenting tanks holding 3000 bbl. each, have a beer-making capacity of about 750 bbl. per mo., the capacity of the brewery being determined by the number of units installed. Fermentation is under complete control at all times, the speed of fermentation being due to the intimate mixture of yeast and wort brought about by agitation with CO_2 gas from the bottom of the tank. Throughout the process the brewmaster has complete control and the possibility of infection is removed. Cellars are eliminated and with them the need for refrigerating the rooms, the temperature control being confined to the vessels.

Smoke Abatement Association Convention

Smoke Abatement and Fuel Economy were Topics for Discussion at Convention Held in La Salle Hotel, Chicago, June 20 to 23.

OUT OF THE many papers and discussions presented during the four-day, Twenty-seventh Annual Convention of the Smoke Abatement Association held at the La Salle Hotel in Chicago, under the chairmanship of President Frank E. Trumble of Buffalo, beginning June 20, one draws the conclusion that the scientist, engineer and equipment manufacturer have made smokeless combustion entirely possible, that the fly-ash question is yielding to solution, and that sulphur gases still withhold the secrets of their economical abatement.

While a great share of the program was given to the problems of the railroads, the technical problems of the steam power plant were not neglected and several papers presented valuable material on furnace design, fly-ash elimination and fuel economy.

Personal Interest Necessary

Throughout the entire convention, inspirational addresses were given with the obvious intent of stimulating the audiences into more active personal interest in the smoke abatement problems, for the opinion seemed quite general that the smoke problem has now reached the stage where the personal element is the principal block in the way of clear air for cities. Among the speakers whose remarks dealt with smoke ordinances and their enforcement were Thos. E. Donnelly, Jos. Harrington, E. L. Woodward, B. R. Gebhart, R. E. Turner, W. A. Matheson and Homer Linn.

Technical papers dealing with subjects in the power plant field contained a great amount of information which will prove helpful to engineers faced with smoke abatement problems. Harry C. Carroll, Director of Engineering, Commercial Testing and Engineering Co., showed several examples of furnace and boiler designs that were modified to meet modern conditions. Principles in Boiler Plant Design Essential to Smoke Abatement was the title of his paper. A. E. Grunert, Efficiency Engineer, Generating Stations, Commonwealth Edison Co., discussed the principles of operation essential to smoke abatement calling particular attention to the difficulties encountered in burning Illinois coal and the work of H. F. Johnstone in his research dealing with the elimination of sulphur gases.

Thos. Marsh, of the Board of Advisory Engineers to the Smoke Inspection Dept., Chicago, presented for discussion a list of items having to do with stoker requirements for smoke elimination, and John J. Tobin of the American Blower Corp. described the latest equipment for the elimination of the fly-ash nuisance, presenting information on settling chambers, electric precipitators, water sprays, centrifugal devices and fabric filters.

Power *for the* New City Hospital

Two 300-kw. Engines and Three 250-hp. Stoker Fired Boilers Serve New Institution Built Recently with $1,800,000 Bond Issue

By G. B. ZELLER,
CHIEF ENGINEER

LAST FALL Springfield, O., opened its New City Hospital, the third building to be used by the city for this purpose since 1887. The group, consisting of a double "Y" shaped, 11 story, main building, a 4-story nurses' home and a combined power plant and laundry building, was built from a $1,800,000 bond issue voted in 1928. Marley W. Lethly and Eastman & Budke of Springfield were associate architects. Associated with them in the design were Tietig & Lee, hospital architects, and Fosdick & Hilmer, consulting engineers, of Cincinnati. The general contract was let in March, 1931, and the corner stone laid in September of the same year.

Capacity of the hospital is 259 beds (exclusive of 72 bassinets) and the staff personnel numbers 225. A cost summary of the building and major equipment is given in Table I as $1,466,641.73, which is approximately $5,700 per bed or $7.30 per sq. ft. Buildings are of the modern type of architecture, the general scheme being gray buff brick with Bedford stone trim. All the buildings are connected by tunnels.

The main floor of the power plant is divided roughly into three sections: the boiler room; the engine room, with the generators, switchboard, service pumps and water softener; the refrigerating and ice making machinery rooms. On the second floor is the laundry with four washers and necessary ironing, drying and disinfecting equipment.

In the boiler room are installed three 2510 sq. ft. 180 lb. three drum, low head room Vogt boilers, with the center line of the lower drum set 9 ft. 6 in. above the boiler room floor. Boilers are fired by Detroit single retort underfeed stokers with individual American Blower Co. forced draft fans, air ducts and blast gates located directly in front of the stoker front plates. Fans and stokers are driven through a lineshaft located in a trench in the floor, by two 6 by 6 in. Clarage engines located at the side of the boilers, either engine driving one or all stoker units.

One boiler is set separately and the other two are set in a battery. Fan and stoker speeds are controlled by a Ruggles-Klingemann pressure regulator. The three boilers are served by a 155 ft. high, 5 ft. 6 in. diam. (at the top) Rust stack. During the winter the steam load averaged around 275 b.hp. and was usually carried on one boiler. In order to insure the protection needed in this service, boiler sizes were selected so that

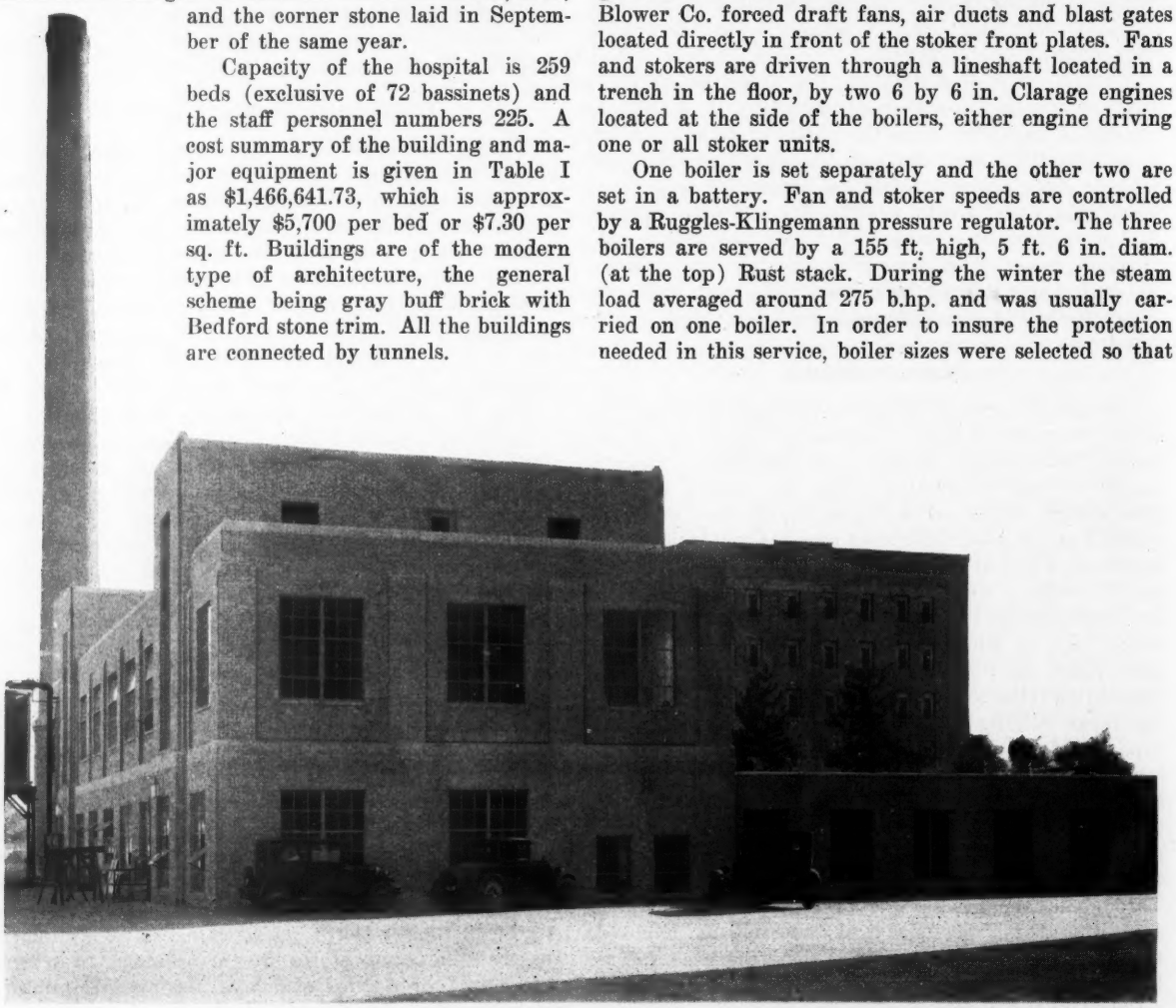


FIG. 1. THE POWER PLANT IS A SEPARATE BUILDING WITH A SPRAY POND ON THE ROOF

tal *at* Springfield, Ohio

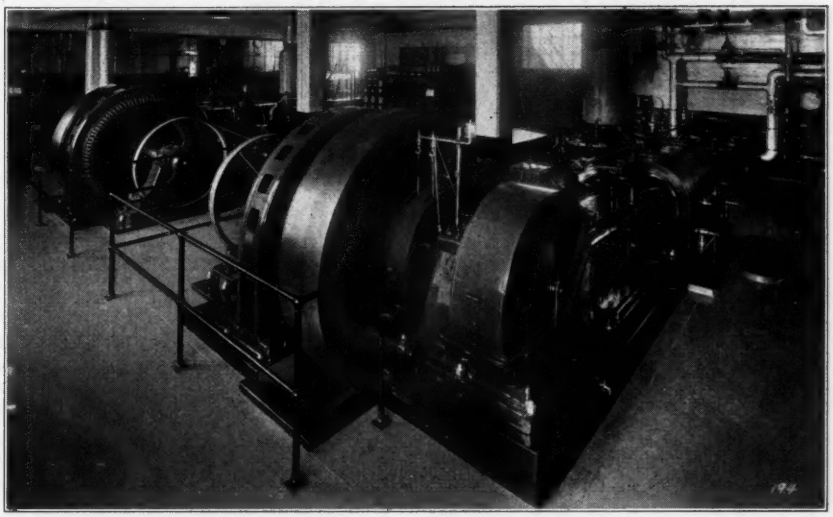


FIG. 2.

Engine Room Looking Toward the Boiler Room and Switchboard

two boilers would readily carry the maximum load but so designed that in emergencies one boiler could carry the entire load, thus insuring continuous service under the most adverse conditions.

Boilers are operated at 160 lb. gage and are equipped with Ruggles-Klingemann pressure control, Republic draft gages, CO_2 and steam flow meters, Diamond soot blowers, Crosby steam gages, Copes feedwater regulators and Lunkenheimer blowoff valves. Feedwater is heated in a Hoppes open type, V-notch deaerating heater set above the two 10 by 6 by 10 in. McGowan outside, center packed, horizontal duplex feed pumps. About 15 ft. above the heater is a surge or return tank which receives all returns, the surge tank and heater being piped so that either can be cut out for repairs or inspection without interfering with plant operation.

At present a Kentucky coal running around 13,800 B.t.u. per lb. is being burned. It is received by truck, dumped in a hopper and fed by an apron feeder to a "V" bucket elevator and conveyor for delivery to the bunker. From bunker it is fed by gravity through a weigh larry to the stoker hoppers. The Columbus feeder elevator and conveyor is driven by a 7½ hp. motor. The bunker with a capacity of 135 tons is of the Allen-Sherman-Hoff sectional cast-iron type. Ash is handled by a United Conveyor Corp. steamatic conveyor discharging to the outside hopper visible at the left-hand side of the power plant photograph. Steam to the vacuum jet is controlled by a motor driven valve with push button control. A glass partition, visible in the engine room picture, separates the boiler room from the engine room.

Engine Room

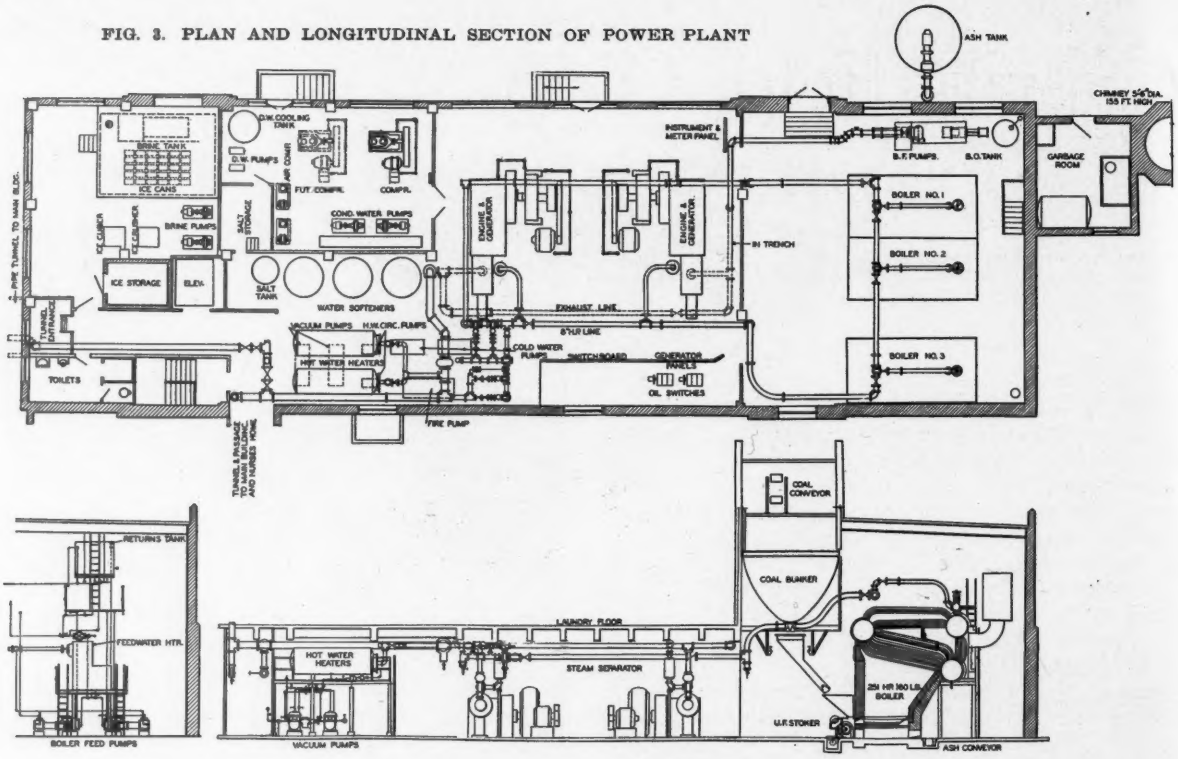
Power is generated by two 480 hp., Elliott single cylinder, horizontal, 22 by 24 in., 200 r.p.m. uniflow engines direct connected to 375 kv.a., 0.80 p.f., 230 v., 3 ph., 60 cycle Elliott generators. Each unit has 15 kw., 125 v., d.c. exciters which are driven by V-belts from the main shaft. The switchboard is 12 panel black slate of Elliott and Westinghouse manufacture with Condit switches and two Allis-Chalmers (Brown-Boveri) voltage regulators. Two of these panels are incoming lines of the Ohio Power Co., a connection required by the law making it necessary to have two independent sources of electric supply for the operating room. This double service has been extended somewhat and in case of failure of the hospital power supply the operating room lights, X-ray equipment, some emergency lights and two of the elevators are automatically cut over to the power company lines.

Steam at 160 lb. is supplied to the engines through Hoppes separators; at 100 lb. through McAlear and Fisher reducing valves to the laundry; at 60 lb. for the sterilizing equipment; at 30 lb. to the kitchen; at from 0 to 3 lb. to the heating system, this latter normally being the exhaust from the engines and pumps. The heat balance is exceptional as no exhaust steam is wasted excepting when the outside temperature exceeds 50 deg. F. It is then discharged to atmosphere through Hoppes exhaust heads on the roof. Armstrong high pressure traps are used throughout.

In this same room are three Scaife Zeolite softeners with a capacity of 20,000 gal. each and various service pumps including a 14 by 7½ by 12 in. Worthington Underwriters fire pump. City water coming into the plant is metered by an 8 in. Worthington compound meter. General service water is pumped to supply tanks by two float controlled 140 g.pm., 60 ft. head, Goulds pumps driven by Robins & Myers 5 hp. motors. All condensate from heating systems, etc., is returned to the surge tank by two American 10 by 14 by 12 in. simplex steam vacuum pumps. These are controlled by Warren Webster regulators. Softened hot water is heated in three Patterson-Kelley heaters.

Supply and return mains to the heating systems in the main buildings are carried through tunnels, the return lines being made from an 85 per cent copper pipe. The heating system is the Webster Moderator with centralized control from an 8 ft. thermostat on the roof of the main buildings. Radiators are in general of the plain pattern hospital type hung on walls, although Herman Nelson concealed radiation is used in the public rooms of the main buildings and cast iron radiators concealed behind grilles are used in the more prominent rooms of the nurses' home. All the more important

FIG. 3. PLAN AND LONGITUDINAL SECTION OF POWER PLANT



rooms are controlled with Johnson automatic temperature regulators. In the general rooms the temperature adjustment range is 6 deg.; in the private rooms and wards 10 deg. from 68 to 78 deg. F.; in the operating room 30 deg. from 70 to 100 deg. F.

The hospital building has ten fan systems which exhaust from the kitchens, dishwasher rooms, toilet rooms, serving rooms, isolation ward toilets, X-ray department, operating rooms and delivery rooms. A special Carrier system conditions the air supply to the operating room where air is required at 85 deg. F. and 64 per cent relative humidity. All fans are remotely controlled from the rooms which they serve. Many of them are arranged for two speeds, either of which may be selected at the remote control station. All exhaust fans, except the kitchen exhaust, have a damper in the discharge, which automatically closes when the fan is shut down. Exhaust ducts from the ranges are made of 14 ga. iron and treated the same as a smoke flue. There is a by-pass around the fan, which is opened by a damper with a fusible link in case of fire.

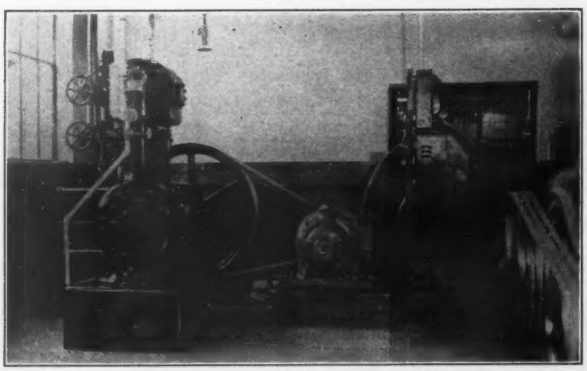


FIG. 4. ONE AMMONIA COMPRESSOR IS INSTALLED WITH SPACE AVAILABLE FOR A SECOND UNIT

A 20 t., 8 by 8 in. Frick vertical duplex ammonia compressor is used for ice and refrigeration use throughout the hospital. This equipment is separated from the engine room by double doors and the compressor is driven through V-belt drive by a 40 hp. slip ring motor. A Marley Cooling Equipment Co. spray pond on the roof cools the compressor jacket water which is circulated by two Goulds 130 g.p.m., 70 ft. head, 1750 r.p.m. pumps driven by 5 hp. motors. The ice freezing tank with thirty-six 100 lb. cans, the ice storage, the brine cooler, Cochrane Corp. ice breaker, Blakeslee ice cuber is in a separate room. Brine is circulated all over the hospital by two Goulds 90 g.p.m., 120 ft., 1750 r.p.m. pumps driven by 7½ hp. motors. Cooled drinking water is circulated by two 5 in. dia. Goulds pumps driven by ½ hp. motors. Compressed air for operating the heating controls and the Johnson service control on the heating tanks is supplied by two 5 by 3 by 3½ in., two stage Ingersoll-Rand air compressors driven by 3 hp. General Electric motors.

Two main and one service elevator serve all floors. Each has a handling capacity of 3000 lb. and a speed of 400 f.p.m. with a platform large enough to accommodate stretchers. They are all of the Otis selective push button control type arranged for fully automatic or semi-automatic operation. A separate elevator is used for the one floor rise to the contagious ward and there is also an elevator in the nurses' home and in the power plant for handling laundry. Six dumb-waiters are controlled by operators in the basement with plug jacks.

In the physical therapy department of this hospital are apparatus and skilled personnel for the administra-

TABLE I. TABULATION OF BUILDING AND GENERAL EQUIPMENT COSTS.

Excavating	$ 6,156.00
General Contract	833,385.00
Plumbing	123,930.73
Heating	85,710.00
Electrical	67,559.00
Ventilating	19,765.00
Temperature Regulation	10,530.00
Pipe Covering	15,780.00
Elevators	67,900.00
Kitchen Equipment	29,992.00
Refrigerators	13,150.00
X-Ray	21,700.00
Sterilizers	19,062.00
Electrocardiograph	1,500.00
Coal Handling	10,400.00
Ash Handling	3,476.00
Water Softener	5,600.00
Refrigerator Equipment	16,700.00
Painting	735.00
Laundry	43,032.00
Engines	40,450.00
Stokers	6,998.00
Boilers	21,856.00
Smoke Breeching	1,225.00
	$1,466,641.73

tion of electrotherapy, Ultra Violet rays, hydrotherapy and thermotherapy. The Electrocardiograph which consists essentially of a sensitive string galvanometer, which responds to the minute electric currents generated by the human heart and recorded photographically, is wired so that the readings may be taken in any one of a number of rooms and recorded on the central Electro-

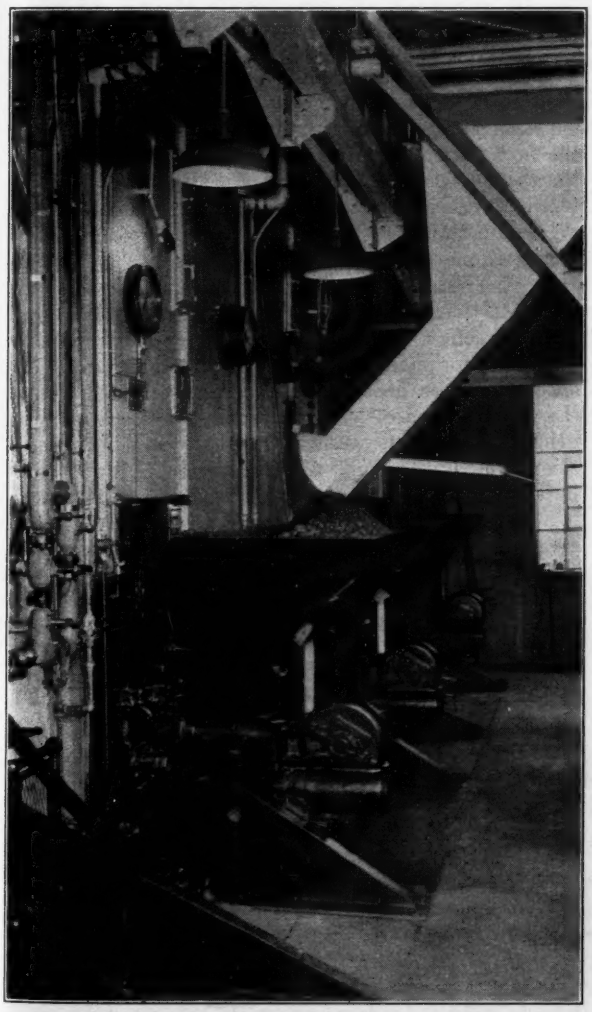


FIG. 5. THE FIRST TWO BOILERS ARE SET IN A BATTERY, THE THIRD IS SET SINGLY

FIG. 6. PUMPS AT ONE END OF THE ENGINE ROOM

cardiograph instrument. The X-ray and deep therapy equipment is among the largest available today; the transformers have a maximum potential of 400,000 volts.

The power plant, together with the other mechanical and electrical apparatus in the hospital, was designed and laid out by Fosdick & Hilmer, Consulting Engineers of Cincinnati, Ohio.

PRINCIPAL EQUIPMENT

Boilers—Henry Vogt Machine Co., 3, 251 hp., 180 lb., 3 drum, low-head room type.
Stokers—Detroit Stoker Co.
Stoker Engines—Clarage Fan Co.
Forced Draft Fans—American Blower Co.
Damper Control—Ruggles-Klingemann Mfg. Co.
Feedwater Heater—The Hoppes Mfg. Co. V-Notch, open type, deaerating heater.
Soot Blowers—Diamond Power Specialty Corp.
Blow-off Valves—Lunkenheimer Co.
Coal Handling Equipment—Columbus Conveyor Co.
Coal Bunker—Allen Sherman Hoff Co.
Ash Conveyor—United Conveyor Corporation.
Feedwater Regulators—Northern Equipment Co.
Boiler Feed Pumps—John H. McGowan Co., 2, 10 by 6 by 10 in. outside center packed, horizontal duplex.
Draft Gages—Republic Flow Meters Co.
Steam Flow Meters—Republic Flow Meters Co.
CO_2 Meters—Republic Flow Meters Co.
Steam Pressure Gages—Crosby Steam Gage & Valve Co.
Indicating and Recording Pressure Gages and Thermometers—Consolidated-Ashcroft-Hancock Co., Inc.
Piping—Hufman-Wolfe Co.
Iron Body Valves—Lunkenheimer Co.
Brass Valves—The Wm. Powell Co.
Water Valves—Crane Co.
Steam Traps—Armstrong Machine Works.
Exhaust Heads—The Hoppes Mfg. Co.
Steam Separators—The Hoppes Mfg. Co.
Stack—Rust Engineering Co.
Steam Jet Ash Conveyor—United Conveyor Corp.
Engine Generator Sets—Elliott Co., 2, 22 by 24 in., 480 hp., 200 r.p.m., 165 lb. ga., 2 lb. back pressure, single cylinder, horizontal uniflow, direct connected to a 300 kw., 80 per cent power factor, 240 v., 3 ph., 60 cycle generator, each engine with a 15 kw. 125 v. exciter driven by V-belt.
Switchboard—Elliott Co., 12 panel black slate.
Voltage Regulator—Allis-Chalmers Mfg. Co., Brown-Boveri.
Recording Watt Meters—Esterline-Angus Co.
Oil Switches—Condit Electrical Mfg. Corp.
Hot Water Heaters—Patterson-Kelley Co.
Hot Water Thermostatic Control—Johnson Service Co.
Hot Water Pumps—Goulds Pumps, Inc., 2, 4¾ in. driven by 1 hp., 1750 r.p.m. motors.
Water Softeners—The Wm. B. Scaife & Sons Co., three Zeolite softeners with filters and auxiliary equipment, each with capacity of 20,000 gal. between regenerations.
Water Meter—Worthington Pump & Machinery Corp.
Service Water Pump—Goulds Pumps, Inc., 2, 140 g.p.m., 60 ft. head, 2 in. centrifugal pumps driven by 5 hp., 1750 r.p.m. motors.
Refrigerating Equipment—Frick Co., 8 by 8 in. vertical duplex compressor driven by V-belt by 40 hp. motor with condensers, evaporators and auxiliaries.
Circulating Water Pumps—Goulds Pumps, Inc., two 130 g.p.m., 70 ft. head centrifugal pumps driven by 5 hp., 1750 r.p.m. motors.
Ice Water Pumps—Goulds Pumps, Inc., 2, 5 in. centrifugal pumps driven by ½ hp., 1750 r.p.m. motors.
Ice Breaker—Cochrane Corp.
Brine Pumps—Goulds Pumps, Inc., two 90 g.p.m., 120 ft. head centrifugals driven by 7½ hp., 1750 r.p.m. motors.
Expansion Valves—Frick Co.
Refrigerator Rooms and Boxes—Jewett Refrigerator Co.
Ice Cuber—Blakeslee & Co.
Heating System Control—Warren Webster & Co.'s Moderator System.
Room Thermostats—Johnson Service Co.
Vacuum Pumps—American Steam Pump Co., two 10 by 14 by 12 in. simplex steam pumps with Bowser lubricators.
Air Compressors—Ingersoll-Rand Co., 2, 3 and 5 by 3½ in. type 3, 2-stage air compressors, driven through Dayton Cogbelts by 3 hp. General Electric motors.
Fire Pump—Worthington Pump & Machinery Corp., 14 by 7¼ by 12 in. steam driven Underwriters fire pump.

POWER PLANT ENGINEERING August 1933

This is the third article in the series. The first by Mr. Gaffert appeared in the April issue and dealt with the location of heaters in the cycle and the most suitable feedwater temperature. The second by Mr. Wheeler appeared in two parts in the May and July issues and dealt with the size of heaters, heat transfer and water friction.

EXTRACTION HEATERS *in the* POWER PLANT

By
GUSTAF A. GAFFERT

THERE ARE a few criterions which may be used to check the performance of extraction heaters. The overall heat transfer coefficient while interesting is not as illuminating as the hotwell depression and terminal difference. The method of obtaining the heat transfer coefficient is merely the application of the heat balance formula while hotwell depression is the difference between the saturation temperature of the steam to the heater and the temperature of the condensed steam or drain from the heater. Horizontal heaters show less hotwell depression than vertical heaters probably because the path from the steam inlet to the hotwell of the heater is more direct. Comparison of test results where temperature and pressure readings were taken show that in the case of horizontal heaters the depression may range from a slight reheating to two or three degrees refrigeration. Vertical heaters show depressions amounting to 10 to 15 deg. F.

Terminal difference may be defined as the temperature difference between the condensate leaving the heater and the drain from the heater. This varies from 1 to 12 or 15 degrees in normal operation with a tendency to increase with load or flow of condensate through the heater. It is evidently desirable to have a minimum depression and terminal difference in order to decrease the work of the following heaters as well as to approach the theoretical cycle efficiency as nearly as possible. In the plant considered previously* a decrease of feed temperature of 10 deg. F. at full load would cause a decrease of one per cent in cycle efficiency.

In the design of the feedwater heating system considerable thought must be given to extraction heaters. The extraction lines from the turbine must be proportioned for maximum flow and pressure drop. The lowest pressure heater often operates on pressures in the neighborhood of 5 lb. per sq. in. abs. So a pressure drop of 1 lb. causes a relatively great decrease in saturation temperature and therefore exit feedwater temperature. When designing on a velocity basis, velocities of 4000 to 8000 ft. per min. for full load flow, will give a good balance between line cost and pressure drop,

*See Part 1 of this series on page 164 of the April issue. This was a 1200 lb., 800 deg. F. plant with 6 heaters and a final feed temperature of 450 deg. F.

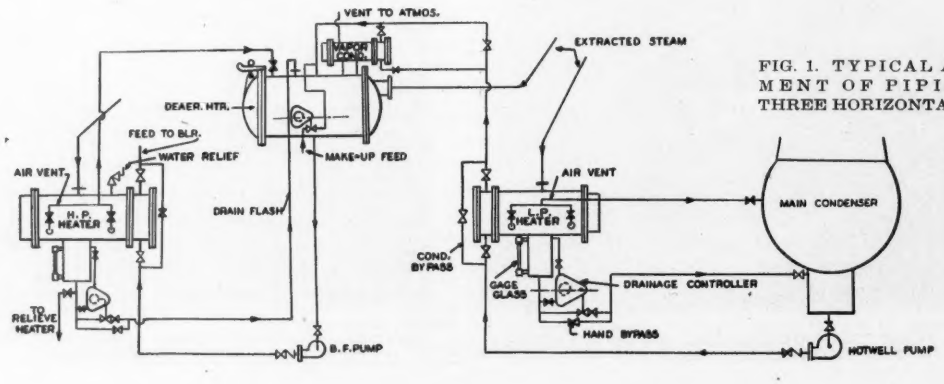


FIG. 1. TYPICAL ARRANGEMENT OF PIPING WITH THREE HORIZONTAL HEATERS

the lower figure being used on the lowest pressure lines.

Again the same question arises with regard to drainage piping where velocities of 4 to 8 ft. per sec. are an economical compromise. When drainage controllers are used to permit the intermittent or regulated discharge of condensate from a heater a different problem arises beyond the controller discharge. Usually the drainage is conducted to a region of lower pressure and we have immediate flashing of at least part of the drain. The line beyond the controller should therefore be designed for flow of vapor, such a line being as free of elbows and sharp turns as possible. Drainage controllers are customary practice on individual heaters and where the condensed steam is to be returned to the main condenser. The selection of suitable drainage controllers must take into consideration the pressure difference across the valve, the temperatures and flow quantities. A design that does not take into consideration the flashing of steam at the valve discharge is more than likely to give trouble in operation.

Typical Designs

A typical heater arrangement using either horizontal or vertical heaters may prove interesting. Referring to Fig. 1 we have a horizontal heater installation shown diagrammatically. From a purely operating viewpoint it is necessary to provide access to the heaters whether they are placed in the turbine room basement or the so-called heater bay. Tube pulling space must be provided opposite the water box end of the heater. Heaters should always be provided with gauge glasses on the heater hotwells to enable the operator to see at a glance the height of water drain below the heater. In the case of horizontal heaters an elongated hotwell below the shell of the heater is an asset in keeping the lower tubes free of condensate and rendering them effective.

Venting

Retention of air and noncondensable gases in the steam space of the heater has a considerable effect on the reduction of the steam film coefficient and thus heat transfer, making proper venting an important point. Air saturated with moisture is denser than than steam and settles to the bottom of the heater and may be withdrawn as shown in Fig. 1, at least two points being used if the heater is of some length. In order to reduce the loss of steam vapor the lines are small and globe valves are used to throttle the line. A condensate by-pass must be provided around the heater to facilitate cutting it out of service for maintenance. If the condensate is sent to a deaerating heater with a vapor or vent condenser, the condensate may be used to condense these vapors and then fed to the heater proper for direct contact heating. It also serves dual purpose in that the plant makeup water can also be float regulated to this heater.

A high pressure heater, if employed, is on the discharge side of the boiler feed pump and its tubes are therefore subjected to full boiler feed pressure requiring more rugged tube design. In addition to the usual drain arrangements special provisions should be provided for such an emergency as a split tube. It is conceivable that a split tube might fill the steam space of the heater with water faster than the drain line could remove the water, building up pressure in the heater unless relieved by a water relief valve so a quick method of spilling the water from the heater to waste or a storage tank is advisable.

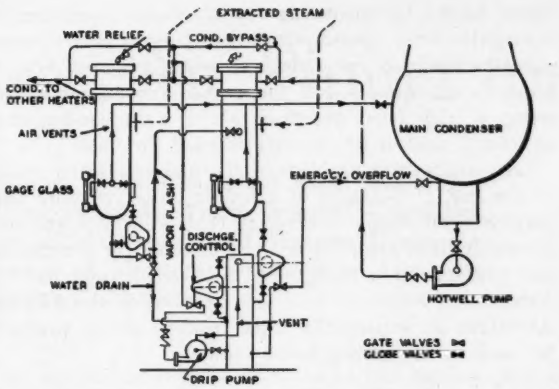


FIG. 2. VERTICAL HEATERS ARE BECOMING POPULAR BECAUSE THEY OFFER ADVANTAGES IN MAINTENANCE AND PIPING

With regard to venting, controller float cages should be vented back to the heater shell proper to equalize pressure. All extraction lines should be drained at their respective low points. The use of check valves in bleeder lines is universal and turbine manufacturers insist upon their installation. It is apparent that if drainage is not removed and water builds up in the heater until it flows back into the turbine extraction stages it might become a considerable drag on the periphery of the stage wheel and cause it to rupture with serious damage.

Short Lines

A station arrangement can sometimes be made which permits short bleed lines from the turbine. A minimum of short bends presents an ideal condition which is closely approached by vertical heaters arranged in a row according to condensate flow. A vertical heater arrangement is shown in Fig. 2. Such an arrangement has several advantages to offer. If the heaters can be located where the heads are accessible to the crane hook, the problem of maintenance and tube bundle removal is greatly facilitated. Again if the heaters can be arranged in a row the main condenser condensate piping can be simplified. Noncondensable gases are tapped off near the bottom of the heater at one or more points and conducted through globe valves to a region of lower pressure. Where there are several heaters in a row the disposal of the vented gases becomes a problem, and in some cases the proper terminus of the header is the main condenser thus relieving the individual heaters of cascaded gases.

Gage glasses near the bottom of the heater are indispensable for operation. One possible system of cascading drainage is shown diagrammatically, the combined drainage of the two heaters being returned to the condensate feed header beyond the exit from the heater. The tank or well below the lowest pressure heater becomes in effect a hotwell and a suction well for the drip pump. The pump may be kept from becoming

vapor bound by throttling the discharge according to the suction level. Inasmuch as the lowest pressure heater operates almost on condenser pressure, a hotwell type of pump is mandatory and to provide for outage of the pump a high level overflow to the main condenser is necessary, such a line being designed for flash.

An interesting problem of thermal expansion occurs in the case of isolation of a heater under varying temperature conditions. Assuming that both inlet and outlet water lines are shut off it is possible for a considerable pressure to be built up in the flooded water box. A water relief valve set at a safe pressure is the solution. As might be expected U tube heaters would probably be used in the arrangement shown.

Insulation

It is of importance to conserve the heat in the feedwater obtained from the extracted steam. Where there are three or four heaters the temperature gradient is such that the condensate leaves the condenser at 60 to 80 deg. F. and is heated to 350—450 deg. F. The lowest pressure heater receives condensate which is elevated only a few degrees above room temperature so only a small thickness of insulation is justifiable. The condensate line leaving the heater would be insulated and all heaters following. To keep down radiation losses in the case of the higher pressure heaters, however, an increasing thickness of insulation is warranted because the temperature difference becomes greater. Theoretically a balance results when the fixed charges on the insulation in place are equal to the value of the heat lost.

Instruments

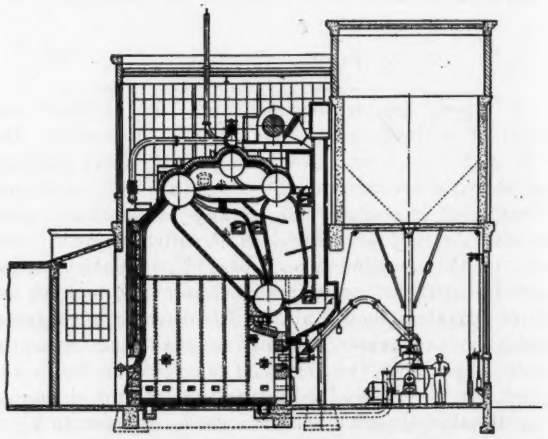
In the normal operation of a plant working on the extraction cycle it is of importance that the operators should know exactly how the heaters are functioning. When heaters are located on one level in the plant it is not difficult to make a periodic check of the readings of indicating pressure gages and thermometers. To obtain a continuous check of heater equipment, however, it is necessary to locate at some central point, such as a gage board recording thermometers the sockets of which are installed very close to the inlet and outlet connections on the water box of the heater. Two pens on one chart showing inlet and exit temperature gives the overall temperature rise and indicates how effectively the heater is operating.

When complete checks are made on extraction heaters, besides the regular gages and open scale thermometers, it is advisable to make provision for test wells in the condensate lines, steam lead to the heater, or condensate nozzles on the water box and steam inlet nozzle as well as the drain line from the heater. When a heater works under a vacuum a spring gage is not of sufficient accuracy to check the pressure at the heater, especially if the pressure drop from the turbine is also to be checked. Absolute pressure mercury gages or manometers should be employed. Also where cascaded drains are to be returned to the main condensate line from two or more heaters it is necessary to provide some means of measuring flow of returned drainage to enable a quantitative heat balance to be made to check the heater performance.

Small High Efficiency Boiler for Isco Chemical Co.

COMPANIES faced with the problem of modernizing their boiler plants will be interested in the rapidity and success with which the Isco Chemical Co. of Niagara Falls, N. Y., removed old boilers and installed a new unit with all modern features and operating efficiency comparable to the best plants in the country.

In the old plant were two return tubular boilers which were kept in operation while the roof and building were raised to accommodate the new boiler. With the completion of this work, the old boilers were removed and the new one installed with a shut down of only six weeks. It is calculated that the increased overall savings will amortize the entire cost of the equipment, including the changes to the building, in approximately 2 yr., not counting the advantage to the manufacturing processes of more uniform temperatures and pressures furnished by the new boiler.



SECTION THROUGH ISCO CHEMICAL CO. BOILER PLANT

In the new plant, designed and installed by Kennedy-Van Saun Mfg. & Eng. Corp., is one 4-drum, bent-tube type boiler, 393 hp., and an air preheater built in the setting of an air-cooled wall and water wall combined. The boiler is equipped with the Kennedy system of pulverized fuel firing which comprises an air-swept tube mill, equipped with a disk feeder and a Herculite steel lined, heavy duty paddle type fan. Between the feed hopper and the disk feeder is an electrically controlled scale for weighing the coal and recording the amount of coal being fed to the pulverizer.

All the fans are driven by variable speed controlled motors and all regulation is automatic, so that the efficiency of the furnace remains constant even with load fluctuations of from 40 to 200 per cent rating.

In case the furnace fire should be extinguished, an electric eye equipment automatically shuts down the firing equipment, necessitating the use of a push-button control to allow the machinery to start when the fire is again ignited.

Under normal operating conditions at high and low loads, the overall efficiency of the plant, over a period of six weeks, has been maintained at 90.04 per cent with a net efficiency of 88 per cent. Radiation and unaccounted for losses are reported to be less than 1 per cent.

Design of Compressed Air Piping for Industrial Power Plants

Factors to be Considered when Planning a Compressed Air Piping System; Calculation of Initial Pressure and Pressure Drop; Removal of Moisture; Materials to Use. By Henry C. Moffett*

AT FIRST GLANCE it would not appear that the selection of pipe sizes for the conveyance of air under pressure would be a difficult or important matter, yet several factors must be considered before the proper selection can be made.

In the first place, air is a compressible gas and it therefore occupies less space under pressure. This fact is expressed as a law, and according to Boyle may be stated thus:

$$\frac{P_1}{P_2} = \frac{V_2}{V_1} \text{ (At constant temperature)}$$

which says in effect that the initial and final pressures vary inversely as the initial and final volumes, as long as the temperature of the gas remains the same.

Now we know that it requires work to compress air, and that this work done, or energy expended, to force air into a smaller space raises the temperature of the air, but in usual practice, the heat of compression is removed by intercoolers and aftercoolers. This reduces the temperature of the air to the temperature of the surrounding medium of the pipe or pipe line, by the time the air has entered such lines from the customary receivers. Therefore, as far as piping calculations are concerned, temperature may be disregarded.

Data Required for Pipe Calculations

Before calculations can be made to determine the proper pipe sizes, the following data must be at hand:

(a) The volume of air in cubic feet per minute that is to be transmitted.

(b) The length of the pipe line, including all equivalent lengths due to bends, turns, elbows, valves or other obstructions.

(c) The initial pressure at which the air is to enter the pipe line.

(d) The amount of pressure drop that may be allowed in that line.

Volume of air required may be arrived at by summing up the air requirements of the various pneumatic machines and other devices to be supplied with air under pressure. The equivalent length of the line is the actual length plus equivalents for fittings which cause greater pressure drops than straight pipe.

Figure 1 is an approximate curve of the relation which exists between the pressure drop through turns or bends in pipe to the drop which occurs in equivalent lengths of straight pipe, in terms of pipe diameters. Globe valves will ordinarily have about double the equivalent value of the smallest radius plotted, shown as the radius equal to ½ of the pipe diameter. Gate valves should never be used for throttling, and are therefore either wide open or tightly closed, hence no additional equivalent length need be added for such valves.

Initial Pressure Determination

Knowing the pressure of the air that must reach machines or devices, and allowing a reasonable pressure drop through the pipe line, it is possible to estimate what the initial pressure must be. From these data the actual nominal pipe diameters may be calculated

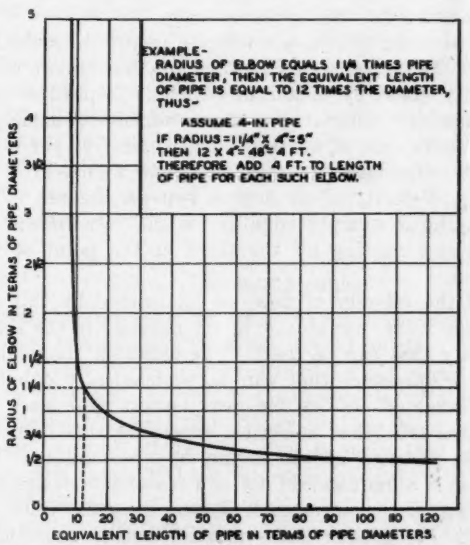

EXAMPLE-
RADIUS OF ELBOW EQUALS 1¼ TIMES PIPE DIAMETER, THEN THE EQUIVALENT LENGTH OF PIPE IS EQUAL TO 12 TIMES THE DIAMETER, THUS-
ASSUME 4-IN. PIPE
IF RADIUS = 1¼" x 4" = 5"
THEN 12 X 4" = 48" = 4 FT.
THEREFORE ADD 4 FT. TO LENGTH OF PIPE FOR EACH SUCH ELBOW.
RADIUS OF ELBOW IN TERMS OF PIPE DIAMETERS
0
½
¾
1
1¼
1½
2
2½
3
3½
4
5
0 10 20 30 40 50 60 70 80 90 100 110 120
EQUIVALENT LENGTH OF PIPE IN TERMS OF PIPE DIAMETERS

FIG. 1. AIR FRICTION OF ELBOWS IN TERMS OF PIPE LENGTHS

by the use of a number of selected formulae, or the answer may be read directly from Fig. 2 by the use of a straight edge.

It is not to be expected that calculations, based on imperfect data, will give perfect answers, nor check exactly with field test results. Neither is it possible to refine the data so that close checks can be made, for there are too many variable factors which may affect the final results. Slight changes of temperature or pressure, or both, may make a difference in actual results, yet these calculations and charts are valuable and necessary, and agreements between design predictions and field results are within commercial accuracy.

It is friction in pipe lines that cause pressure drops,

*All rights reserved by the author.

and the loss of pressure increases directly as the length of the pipe and approximately as the square of the velocity of flow at constant volume and temperature; but as the increments of pressure drop along the pipe

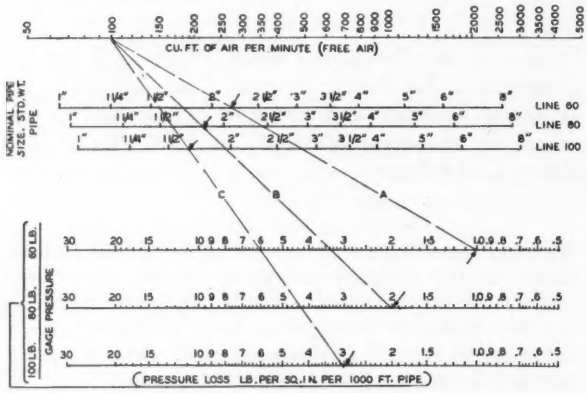


FIG. 2. CHART FOR PRESSURE DROP DETERMINATIONS IN COMPRESSED AIR LINES

line cause increments of volume increase, the relationship is variable.

Figure 3 illustrates graphically the relation existing between velocity of flow and pressure drop per 1000 ft. of pipe for pipe sizes 1 in. to 6 in. inclusive. It is seen that the smaller the pipe, the greater is the drop in pressure for the same velocity.

It is claimed that air velocity in pipes should never exceed 25 ft. per sec. Figure 4 is a convenient volume-velocity chart by means of which it is possible to determine any one of the three variables, namely

(1) Volume of air flowing in cubic feet per minute,
(2) Standard pipe size, nominal diameter,
(3) Velocity of air flow in feet per second,

by laying a straight edge across the two known quantities and reading off the third at the point of intersection.

If the velocity of flow, as determined by this chart, exceeds 25 ft. per sec., it is not necessarily the limiting velocity that can be used. The criterion should be the drop in pressure that can be economically equated to the increased cost of the next largest pipe size. It is perhaps true that velocities exceeding this figure cannot be justified by the saving in pipe, and that therefore such a limit should act as a reasonable design guide, keeping the transmission losses in such lines quite small. Far greater losses usually occur in practice from leaky joints and careless erection.

Pressure Drop Determinations

In using the chart for pressure drop determinations (Fig. 2), the following should be observed: the top line is a logarithmic scale for volumes of free air to be transmitted in cubic feet per minute. If the volume is in any other unit, or as air under a pressure other than 14.7 lb. per sq. in. abs., it must be converted to the unit of the scale, and be at normal atmospheric pressure. If the gage pressure is P_1, and the volume is V_1, then at atmospheric pressure the new volume V_2 may be determined by using the following formula:

$$V_2 = \frac{(P_1 + 14.7)V_1}{14.7} \quad \text{(For sea-level.)}$$

Below the volume line on the chart are three scales marked respectively, "line 60", "line 80", and "line 100", on each of which pipe sizes are shown. The proper line must be used in determining unknowns for problems of pressure drop at 60, 80 or 100 lb. per sq. in. gage pressure. At the bottom of the chart are three logarithmic scales in reverse, on which are shown pressure drops per 1000 ft. of pipe. Here also the proper line must be used according as the gage pressure of the air under consideration is 60, 80 or 100 lb. per sq. in. To use this chart it is only necessary to join scale points representing known data, and project to or intersect for the unknown sought.

Lines "A", "B" and "C" on Fig. 2 are shown as an example to determine the pipe sizes required for the flow of 100 cu. ft. of free air per min., allowing 1 lb. pressure drop at 60 lb. gage, 2 lb. pressure drop at 80 lb. gage and 3 lb. pressure drop at 100 lb. gage pressure. It will be noted that a 2½-in. pipe is required at 60 lb. gage for a drop of 1 lb. and that 2-in. pipes are required for a 2 lb. drop at 80 lb. gage and 3 lb. drop at 100 lb. gage pressure.

Provision for Removing Water

All air contains some water in the form of vapor or steam whenever it is in contact with water and has the power to absorb water from surrounding objects which contain it. When air is compressed and then cooled to the proper point, the dew point is reached and the water drops out and obstructs the flow of

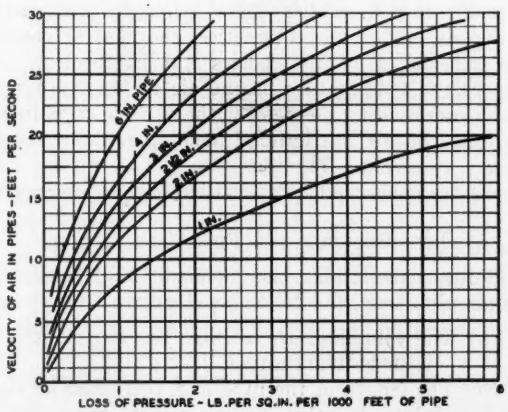


FIG. 3. RELATION BETWEEN AIR VELOCITY AND PRESSURE DROP IN PIPES OF VARIOUS SIZES

the air. It is quite usual to find water in air lines, and good design dictates that a means for the removal of water should be provided. Drips should be installed at several places in such lines, unless the line is very short.

Avoid Pockets

Air lines should slope gradually toward drip points in the direction of flow, so that the water will be carried along with the air. At such points, a riser may be inserted, if necessary, so that several slopes may be installed in a line without sacrifice of elevation. The water may either be blown out at intervals or trapped out. Great care should be taken to avoid sags in the line in which water might stand or accumulate.

Air from compressors and air used by machines rarely flows through pipes evenly, but is quite likely to be flowing as pulsations. In order to smooth out these waves of pressure, large receivers are customarily inserted in the lines just beyond the compressors. In very long lines, others are installed at some convenient points. These receivers not only act as pressure regulators and pulsation dampeners, but also as drip pockets for the entrained moisture. Receivers are usually fitted with sight glasses, and hand operated blowoffs.

Galvanized Pipe Advisable

Compressed air piping is subject to the oxidizing influences of water and air at various temperatures, and it is therefore good practice to use galvanized pipe.

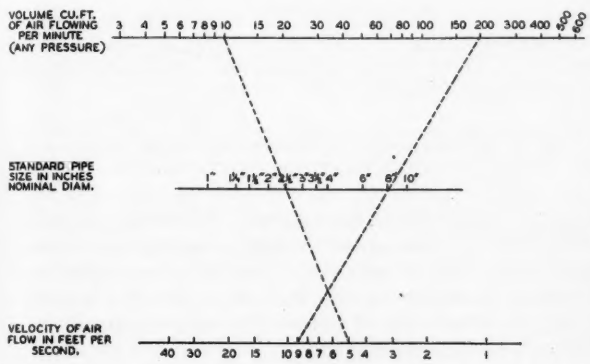

VOLUME CU.FT. OF AIR FLOWING PER MINUTE (ANY PRESSURE)
3 4 5 6 7 8 9 10 15 20 30 40 60 80 100 150 200 300 400 600 800
STANDARD PIPE SIZE IN INCHES NOMINAL DIAM.
1" 1¼" 1½" 2" 2½" 3" 3½" 4" 6" 8" 10"
VELOCITY OF AIR FLOW IN FEET PER SECOND.
40 30 20 15 10 9 8 7 6 5 4 3 2 1

FIG. 4. VELOCITY VOLUME CHART FOR STANDARD PIPE SIZES FROM 1 TO 10 IN. NOMINAL DIAMETER

This not only prevents such rapid deterioration of the pipe, but also prevents the formation of scale which, when it chips loose, may be carried along to some pneumatic machine and become lodged in an air-port or wedged against some moving part of the machine. Fittings, valve bodies, and other specialties in important air lines should be rust-proofed or manufactured from some non-oxidizing alloy.

Anchors and Supports

Gate valves, used for segregating branch lines, should be air tight, hence the common practice of using double disc valves, closely fitted. Globe valves should be fitted with composition discs.

Air lines should be so supported and anchored that pulsations of pressure will not cause them to vibrate and chatter. Hangers should be clamped on securely and restraining rods used if the oscillations are violent or noisy.

In power plant practice, if compressed air lines are to be carried above ground from building to building, there will be a marked difference in temperature of the line in summer and winter, and it is necessary then to provide for expansion and contraction. Slip expansion joints, if leaky, are not as easy to detect as with steam, and unless it is absolutely necessary to use them, it is far better to offset the line by bending the pipe at some convenient point where a vertical or horizontal loop can be supported.

Induction Motor Pointers

By Carl Heyel

IT HAS BEEN estimated that a.c. motors outnumber d.c. motors in the ratio of three to one, by far the greatest number of a.c. motors being of the induction type and of these about 97 per cent squirrel-cage. This widespread adoption of a.c. drive is largely because a.c. energy is more conveniently and economically distributed than d.c., so that power companies have encouraged a.c. service; motor manufacturers have met the demand by developing the induction motor to its present highly serviceable stage. Control has been simplified, and various types designed for such rugged service,—squirrel-cage motors up to 30 hp. are now available for starting directly across the line,—that today large drives may be started and stopped by factory workers who are entirely unfamiliar with electrical equipment.

Wound Rotor or Squirrel-Cage

Wound-rotor motors are seldom used below 400 hp., except where speed adjustment is desired. First cost is generally about 50 per cent higher than for the squirrel-cage and usually maintenance expense is greater. One advantage of the wound-rotor motor is its high torque per ampere unit. For lower power requirements, high starting torque may be obtained with high-resistance, squirrel-cage motors and fairly high torque with the double squirrel-cage. Squirrel-cage types are available for practically every constant-speed application. Design has crystallized into the following four types, recognized as standard by the National Electrical Manufacturers Association: Class A, normal torque, normal starting current; class B, normal torque, low starting current; class C, high torque, low starting current; class D, high slip.

General Purpose Motors

Successful operation at rated load will be obtained, if ambient temperature does not exceed 40 deg. C.; if applied voltage varies not more than 10 per cent above or below nameplate rating; if the frequency of current supply varies not more than 5 per cent above or below nameplate rating; if the location is such that dust, moisture and fumes will not interfere seriously with the motor ventilation.

Ten per cent increase over nameplate voltage results in a slight improvement in efficiency but a great reduction in power factor, with consequent plant distribution copper losses. Starting and pull-out torque will increase in proportion to the square of the applied voltage. Ten per cent overvoltage will not cause excessive heating but speed will increase slightly.

At undervoltage the converse of the above effects will be noted.

Increase in frequency will slightly improve the power factor at which the motor operates but the starting torque will be decreased. Speed, hence friction and windage losses, will be increased. At frequency lower than rated, speed will be decreased, starting torque increased and power factor slightly decreased.

If variations in both voltage and frequency occur simultaneously, the effects listed above will be superimposed.

POWER PLANT ENGINEERING August 1933

Measurement of Temperature in Electrical Windings

By
A. C. FINNEY
Switchgear Eng. Dept.
General Electric Co.

SOME TIME AGO the National Electrical Manufacturers Association standardized on the use of temperature meters utilizing resistance detector coils embedded in the slots under or between windings for determining the temperature of a.c. generator armatures or other machine stators. The reasons underlying this action may be of interest.

The resistance detector coil is wound of fine copper wire into a flattened coil substantially protected with insulating compound and of suitable dimensions to occupy a considerable part of the length of the winding slot in the generator. The detector coil will therefore be affected by overheating at any or all points along the winding in the slot. Corresponding rise in resistance of the detector coil will be a measure of the average rise in temperature of the winding in the slot. (Fig. 2.)

The thermo-couple, on the other hand, is inherently a one-point or "hot-spot" indicator (Fig. 1). The junction point of the two dissimilar metals forming the couple may or may not happen to be located at a point in the slot subject to undesirable temperature rise. It

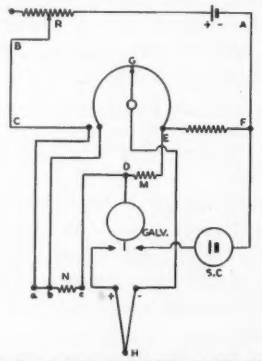


FIG. 1. METHOD OF CONNECTING A THERMO-COUPLE IN THE MEASUREMENT OF TEMPERATURE

might even be placed near a ventilating duct, resulting in a temperature indication much lower than the average for the winding.

These mechanical considerations have influenced machine designers in favor of the embedded resistance detector as being better adapted to the kind of temperature indication desired.

Indication of these temperatures involves electrical transmission to an instrument on the switchboard. The resistance detector scheme simply means the measurement of resistance of the detector and comparing it with that of a standard resistor which does not change with temperature. One method of doing this to give a continuous indication is by means of a modified differential voltmeter, with one winding in series with the detector, and the other in series with the standard. This is a comparatively simple instrument, with plenty of torque for accurate readings, and in some types is independent of operating voltage over a wide range—an added advantage. Calibration in degrees gives indications directly in temperature.

Safety to the operator from leakage or potential charges from the machine windings is assured by use of film cutouts, or preferably by grounding the detector coils at one point if the operating source will allow grounding. An independent operating source is recommended with this point in view. An instrument is now available with self-contained potential transformer and rectifier, providing completely isolated control. A typical diagram for this equipment is shown in Fig. 3.

Where thermo-couples are installed it is necessary to make use of the electromotive force generated by the

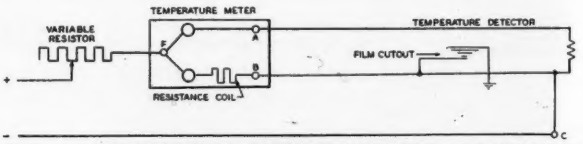


FIG. 2. ELEMENTARY CONNECTIONS FOR RESISTANCE TEMPERATURE DETECTORS

couple itself. For a temperature of 100 deg. C., which is about the maximum working temperature expected on a generator, a commercial type of thermo-couple will provide an e.m.f. of less than 0.5 millivolts. This is a very small amount of potential to operate any type of direct reading instrument.

The more accurate method with a thermo-couple is to compare its potential with a standard by means of a potentiometer bridge and galvanometer. A variable resistor in the bridge is adjusted to give zero reading

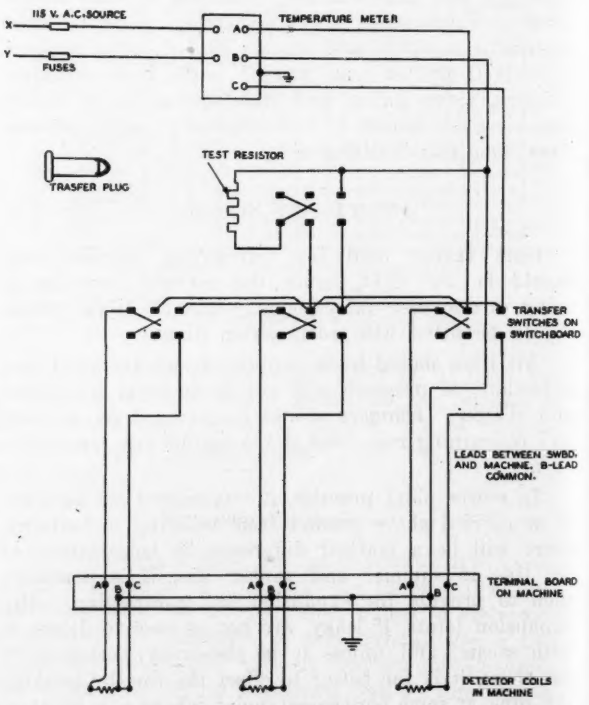


FIG. 3. DIAGRAM FOR RECTIFIED A.C. TYPE OF TEMPERATURE METER

on the galvanometer, and the position of the resistor dial is calibrated in degrees C. This means that a continuous reading is not obtained, as each reading must be preceded by adjustment of resistors and intermittent pressing of the galvanometer button until no deflection is obtained.

Mechanical operation of adjusting the bridge for zero deflection may be taken care of by a motor-operated mechanism, and this is done in several types of recording temperature meters. This relieves the duty on the thermo-couple, but even so the minimum chart used on standard temperature recorders is 0-200 deg. C., which is rather high for a generator winding. One manufacturer of recorders for both types of detectors recommends in favor of the resistance type for readings below 150 deg. C., on account of low e.m.f. generated by the thermo-couple.

Another type of recorder of recent design makes use of photo-tubes to relieve the galvanometer of torque requirements, and will operate at high accuracy with thermo-couples. The expense of a recorder is not usually justified, however, where only an indicating instrument is required.

Many engineers have become familiar with the use of thermo-couples for measuring high temperatures, such as in furnaces, ovens, etc. A commercial thermo-couple can be obtained to give a maximum of about 50 millivolts at 800 deg. C., and to satisfactorily withstand temperatures of this order. Familiarity with this application naturally leads to the consideration or specifying of thermo-couples occasionally in generators. It should be clear from the foregoing, however, that the resistance detector coil is much better adapted to indicating temperatures in generator windings.

Transformers in Open Delta

By V. E. Johnson

UNDER NORMAL conditions a balanced three phase load is best supplied from a closed delta bank. Under the light loadings that prevail at this time, some economies can be effected by cutting out one unit and operating in open delta. The theoretical conditions under which such a change is indicated can be determined by the following simple calculations:

Let F = the iron loss per unit in the bank.

Let C = the full load copper loss per unit.

These values are readily obtained from the performance sheets covering the transformer, or by comparatively simple tests.

Let R = the ratio of $\frac{\text{actual load}}{\text{full load}}$ (on the bank)

The losses in a closed delta bank will then be:

Loss = $3F + 3R^2C$, the copper loss being proportional to the square of the load.

Example: At full load R = 1 and the loss becomes $3F + 3C$, which is, of course obvious.

At ½ load R = ½ and the loss becomes

$3F + 3(\frac{1}{2})^2C$ or $3F + \frac{3}{4}C$

When one unit is cut out, the current per remaining unit becomes $\sqrt{3}$ times what it was before, so that the ratio R is increased to $R\sqrt{3}$. The loss in an open delta bank carrying the same load as the closed delta setting is therefore:

$2F + 2(R\sqrt{3})^2C$ or simplifying, $2F + 6R^2C$

Example: At full load conditions for a closed delta bank, the losses when one unit is disconnected (i.e., R = 1)

$2F + 6C$

In a closed delta bank, then, it is evident that the iron losses are 50% higher than in an open delta bank, but that the copper losses are only half as great.

Under half load conditions for the closed delta (i.e., R = ½) the losses become:

$2F + 6(\frac{1}{2})^2C$ or simplifying, $2F + 3/2C$

Here, as before, the copper loss is exactly twice that for the closed delta bank.

From the above formulas and examples it appears that the ratio R at which the open and closed delta losses are equal depends upon the relation between the iron and full load copper loss per unit. Setting this up as a simple algebraic equation we get:

$3F + 3R^2C = 2F + 6R^2C$ Solving for R we get

$$R = \sqrt{(F \div 3C)}$$

Example: A 2300 v., 50 kv-a., transformer has an iron loss of 218 watts, and a copper loss of 600 watts. The ratio at which the closed and open delta losses are equal is accordingly

$R = \sqrt{(218 \div 1800)} = 0.35$ approx.

That is to say, with a total load of $0.35 \times 150 = 52.5$ kv-a. it would be immaterial from the standpoint of losses whether the bank were open or closed delta. Below that load ratio, the open delta bank would have lower losses, while for larger loads the advantage would be with the closed delta setting.

A survey of the ratio between the iron and copper loss in commercial transformers, discloses that the ratio F/C is usually in the neighborhood of 1/3. If that value be assumed as quite generally applying, the formula for R becomes:

$R = \sqrt{1/9}$ or 1/3

Using this approximation, it may be said that banks carrying less than 1/3 load will operate more efficiently if one unit is cut out of service.

It must, of course, be understood that efficiency alone is not the only criterion, and that the known disadvantages of the open delta, as well as the actual cost of "cutting out" a unit, must be balanced against the savings effected by the reduction of losses. With fluctuating loads, the problem becomes correspondingly complicated.

In any event, the possibility of making a saving by this method should not be overlooked.

Mirrors only 1/64-in. wide, 1/32-in. long and 5/1000-in. thick are used regularly in the General Engineering Laboratory of the General Electric Co. A single one weighs only about three one-millionths of an ounce.

Used in an electromagnetic oscillograph, each mirror is suspended between magnets by two wires, sometimes only three ten-thousands of an inch in diameter; the human hair is usually more than ten times that thickness. The mirror moves with each variation of voltage applied to the wires, and traces these variations by means of a beam of light, necessarily tiny, on a sensitive photographic film.

The mirrors are made in the laboratory by silvering a microscope cover glass, diamond ruling it, and breaking it into 2048 pieces per square inch.

POWER PLANT ENGINEERING August 1933

Features of the Outdoor Mercury-Vapor-Steam Plant *at* Schenectady

EVER SINCE THE first mercury boiler and turbine installation was made by the Hartford Electric Light Co. ten years ago, engineers throughout the world have regarded the development of the mercury steam cycle as applied to power generation with great interest. It was a bold move to attempt the construction of a boiler using mercury for developing power in place of water and as pointed out in a recent article[1] describing the history of this development, many difficulties were encountered at first, but none of them were insurmountable and in the last ten years the work in this field has been fruitful of increasingly greater success. Indeed, in the last few years, the reliability and the economy of the equipment at Hartford has been such, that when the General Electric Co. found it necessary to increase the power and steam requirements at their Schenectady plant about a year and a half or two years ago, they decided to construct a new plant incorporating the mercury-vapor-steam cycle.

Engineers, everywhere, have watched the construction of this plant with great interest, not only because it is at least twice the size of the largest installation at Hartford, but in addition it is one of the first outdoor steam plants, and furthermore it represents a unique solution to a very difficult problem—that of successfully coördinating the difference in the electrical load and steam demands, of public utility and industrial power plants.

The analysis of conditions which ultimately resulted in the decision to build this plant are extremely interesting and are fully described in a paper by A. R. Smith, of the General Electric Co., and delivered at the World

[1] Power Plant Engineering, June, 1933, p. 263.

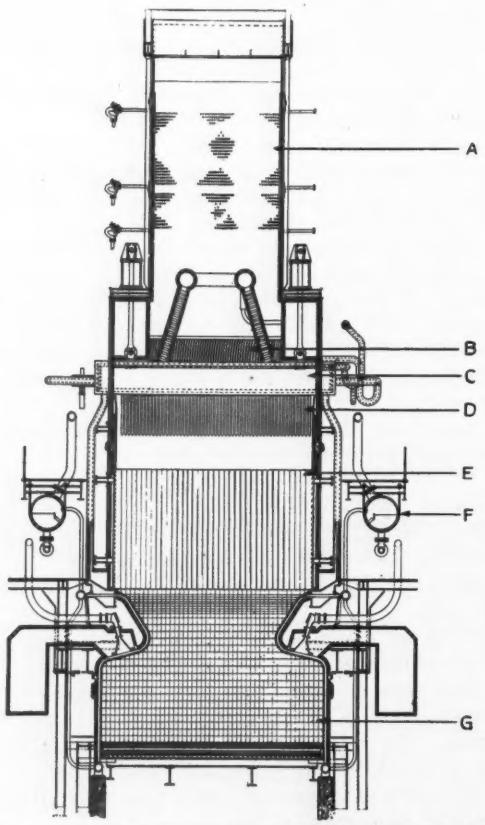


FIG. 1. CROSS SECTIONAL ELEVATION OF MERCURY VAPOR BOILER

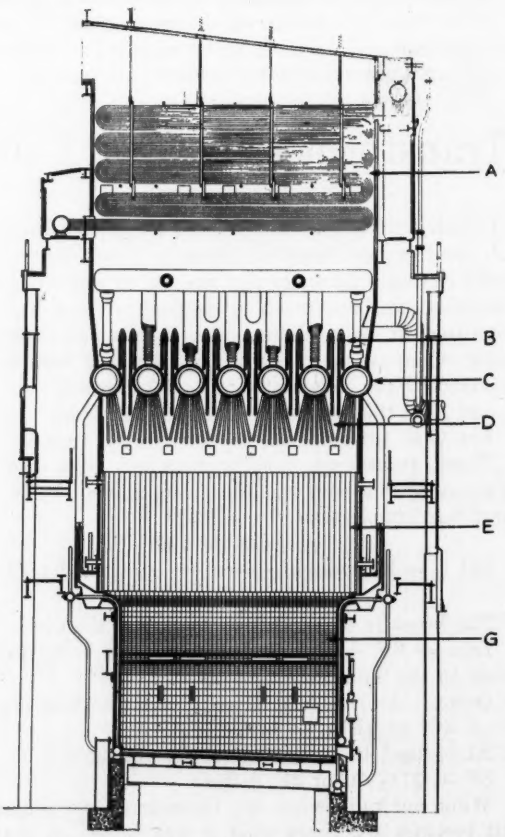


FIG. 2. ANOTHER SECTION OF THE MERCURY-VAPOR BOILER

A, Steam superheater. B, Mercury liquid heater. C, Mercury drum. D, Porcupine tubes. E, Mercury walls. F, Steam drums for water walls. G, Water walls.

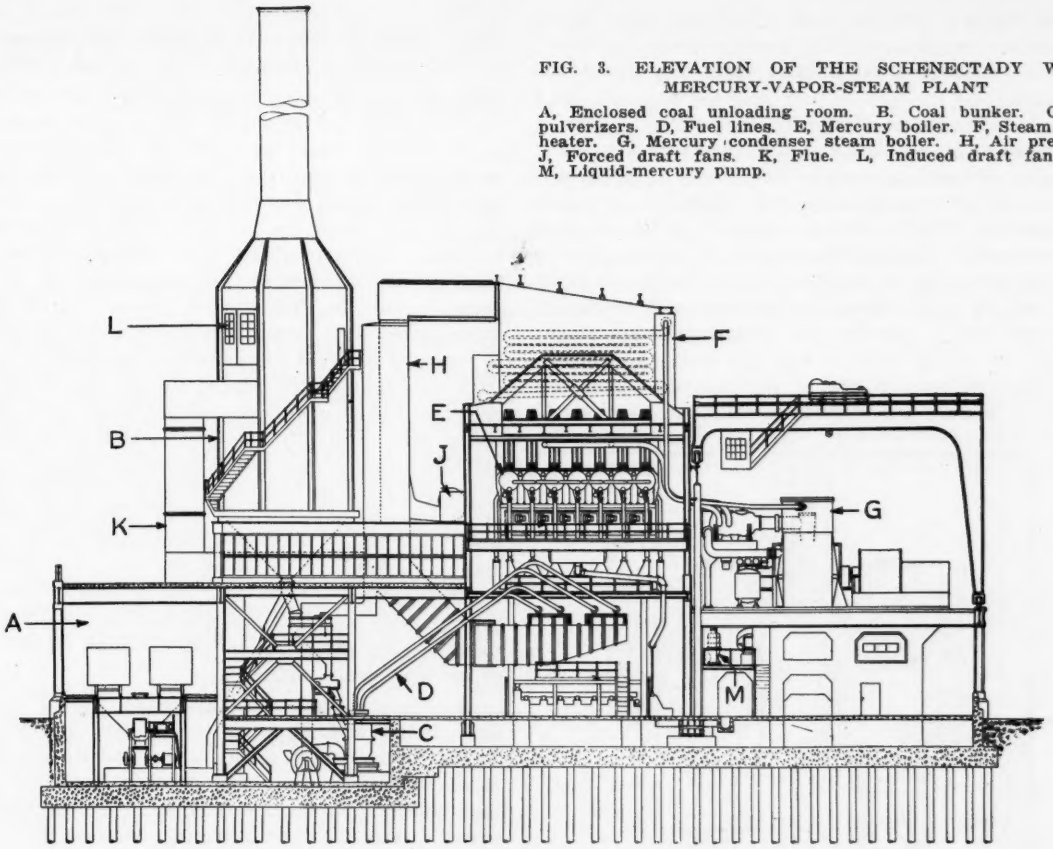


FIG. 3. ELEVATION OF THE SCHENECTADY WORKS MERCURY-VAPOR-STEAM PLANT

A, Enclosed coal unloading room. B. Coal bunker. C, Coal pulverizers. D, Fuel lines. E, Mercury boiler. F, Steam superheater. G, Mercury condenser steam boiler. H, Air preheater. J, Forced draft fans. K, Flue. L, Induced draft fan room. M, Liquid-mercury pump.

Power Conference at Stockholm, Sweden, June 26-July 8, but here we will describe only the constructional features of the plant as given in the paper.

During the construction of the plant modifications had to be introduced so as to increase the steam producing capacity over that figured in the original estimates so that at present the equipment consist of:

One steam boiler 400 lb. per sq. in. gage pressure, 750 deg. F. capable of producing 325,000 lb. per hr.

One mercury boiler and turbine capable of producing 20,000 kw. and 325,000 lb. of steam per hr.

One non-condensing turbine generator for operating from 400 lb. per sq. in. gage pressure to 200 lb. per sq. in. gage pressure and capable of producing 6,000 kw.

The plant, therefore, has a capacity of 26,000 kw. and 650,000 lb. per hr. of steam.

Details of construction are clearly shown in the accompanying illustrations. Figs. 1 and 2 show the mercury vapor boiler. This boiler although different is based upon the design of the porcupine tube boiler used at Hartford. The mercury side walls are shown extending from below the porcupine tubes for a distance of 15 ft. They consist of three steel tubes embedded in copper in a steel armor channel which is calorized. The drums with their porcupine tubes have had sufficient publicity in connection with the Hartford installation to make any description here unnecessary. Between the drums are located the mercury liquid heaters which should be called economizers—in fact they are what are now termed "steaming economizers".

The furnace bottom and the sides for a height of 15 ft. are water cooled with block covered tubes, which is the usual Babcock & Wilcox construction for slag tap furnaces. The 400 lb. steam produced in the mercury condensers, amounting to 240,000 lb. per hr., and the 400 lb. steam produced in the lower section of the furnace, amounting to 85,000 lb. per hr., is superheated to 750 deg. F. in a usual convection type superheater illustrated at the top of the picture.

The mercury turbine is a double flow 5-stage 20,000-kw. unit designed for 125 lb. mercury pressure at the throttle and exhausting at 27.5 in. Hg. vacuum referred to a 30-in. barometer. A cross sectional view of the condenser is shown in Fig. 8.

Figure 4 shows a plan and Fig. 3 an elevation of the station. Unlike the Hartford, Conn., and the Kearny, N. J., installations, the Schenectady mercury turbine is at the usual turbine floor level and the mercury is delivered back to the boiler drums by means of centrifugal pumps. It is interesting to note that the pumping horsepower to return the mercury liquid back to the boiler against 125 lb. per sq. in. gage pressure is only about one-fifth of the horsepower to return the condensate back to a 1200 lb. per sq. in. gage pressure steam boiler of equal capacity. In this case the pump is a single stage overhung impeller of 11 in. diameter running at 1800 r.p.m.

As will be noted from the plan and elevation the mercury and steam turbines as well as the deaerator evaporators, condenser boilers are installed entirely outdoors. So also, the upper part of the boilers and the coal bunkers surrounding the latter are outdoors. A brief discussion of this outdoor feature as presented

by the author, therefore, will be of interest. Every designer's conception of what constitutes an "outdoor" plant is probably different and some may claim the introduction of the idea in part, while others may deny that this apparatus is sufficiently unprotected to deserve such a title. At all events, it may be termed a power or steam generating machine composed of apparatus built by different companies and assembled as a machine with as little housing as appeared to the designer to be essential. The building structure is secondary to the apparatus and is largely of metal so as to resist abuse and to make extensions possible with negligible waste by simply moving the extendable end almost bodily.

Power or heating plants for industry generally grow over a long period during which time styles and

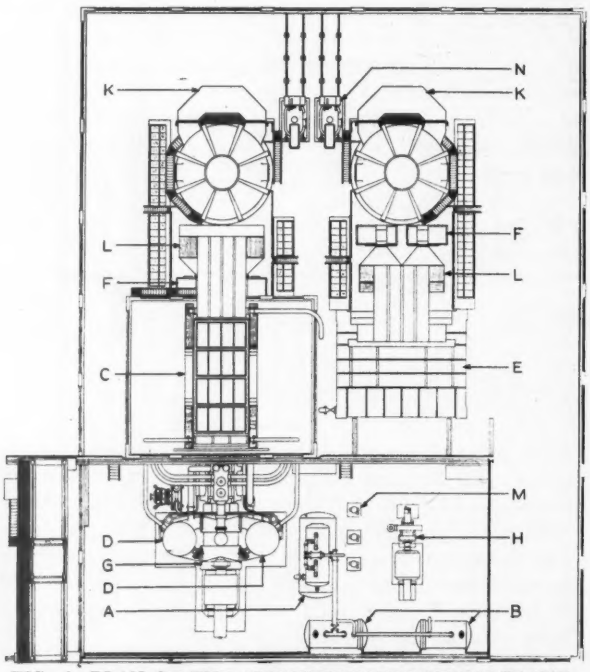


FIG. 4. PLAN OF THE MERCURY-VAPOR-STEAM PLANT
A, Deaerator. B, Evaporators. C, Steam superheater over mercury boiler. D, Mercury-condenser steam boiler. E, Steam boiler. F, Forced draft fans. G, 20,000 kw. mercury-vapor turbine. H, 6,000 kw. pressure reducing steam turbine. K, Flue. L, Air preheaters. M, Feedwater heaters. N, Auxiliary power transformers.

sizes of apparatus change so materially as to make the original building plan quite unsuitable for contemplated new equipment. Furthermore, buildings are especially designed to suit the original equipment and it seems unwise to construct a special building good for a life of 75 yr. to house apparatus which may have to be replaced in 25 yr.

To attempt to show the saving in investment cost would be hopeless because such comparative estimates are based on many assumptions and are subject to the prejudice of the designer, both of which would lead to controversy. There were many such controversies during the era of the introduction of the outdoor electrical substation. At the present time no one questions but what the outdoor substation is cheaper than the housed one, at least for voltages above 15,000 with the possible exception of stations built in congested areas of large cities.

Indoor steam plants have many inherent faults and while correct designs with sometimes accompanying increase in cost may eliminate them, one can hardly point out a single station which is completely free of them.

There are, for example, the possible condensation in the turbine room; the disastrous effect of an oil fire, the explosion hazard from coal dust; the panic of operators in the event of a ruptured steam main; the freezing of water lines due to cold air flowing in through windows; drafts resulting from taking combustion air from inside the building; the gaseous air in the boiler room due to the difficulty of proper ventilation; the accumulated dust throughout the structure which must be removed to avoid spontaneous combustion; the many dark and inaccessible places on the various floors or galleries where operators are stationed and who are not always effectively employed. And there are many hot, disagreeable and awkward places where repairs to apparatus must be made which may be as bad the year around as the objectionable wind, rain, cold and snow conditions which may be encountered in an outdoor station during a portion of the year. It is not the author's intention to belittle the difficulties which may prevail when making repairs in bad weather, but rather to anticipate exaggeration on the part of the critics of outdoor steam plants.

No claim is made that this outdoor plant avoids all such faults and as a matter of fact the apparatus which requires most maintenance, attention and operating supervision has been suitably protected against the weather. In other words, it is a compromise because it was the first attempt; because the mercury boiler is a relatively new piece of apparatus and because the winters in Schenectady are pretty long and severe.

Refrigerating at Boulder Dam

A GIANT REFRIGERATING system to cool off the concrete in Boulder Dam as fast as it is poured and set is being imbedded in the huge project.

Two-inch iron pipe, spaced 10 ft. apart vertically and 11½ ft. apart horizontally, is being installed as fast as the concrete is poured. Through this piping system cold water is circulated constantly to reduce the temperature of the concrete. Huge masses of concrete have the property of greatly increasing their heat after setting. Such a hugh mass as Boulder Dam would require centuries to get rid of the excess heat without artificial aid and the process would result in dangerous open joints or cracks.

Left to itself, concrete rises about 40 deg. F. above its temperature when laid.

The system in Boulder Dam, when the whole project is completed, will entail embedding 800,000 ft. of pipe for the water-cooling system—about 150 mi. of 2-in. iron piping.

Experiments which led to including this cooling system in the specifications for the dam were conducted in the Owyhee Dam on the Owyhee project in eastern Oregon. Pipe 1 in. in diameter was placed there in each of seven consecutive 4-ft. lifts of concrete. This concrete rose to a temperature of 118 deg. as it set. Pumping water at 64 deg. through the pipe system reduced the temperature to 84 deg. in two weeks.

Maintenance of Diesel Engine Valves

Suitable Equipment Must Be Available if Valves Are to Be Kept in Good Condition

By
RICHARD HOWARTH

CONSTANTLY INCREASING adaptation of the Diesel engine to the power plant makes it necessary, or at least advisable, for engineers to become familiar with its maintenance, which is, of course, largely responsible for economic performance over a period of time. In the following paragraphs the author endeavors to present an important feature of the Diesel engine, that is valve maintenance as met with in practical operation.

The average operator knows that the grinding of valves is a routine job and immediately asks how often should they be ground. So many things must be taken into consideration that it is practically impossible to get a definite answer to this question and, in spite of all set standards and general rules, only by careful inspection can the proper time be ascertained. They may be scaled badly in 400 hr. running time or again they may be good after 3000 hr. or more continuous service, depending upon the materials and existing operating conditions.

It should be a set rule that spare valves properly ground be kept on hand at all times. Exhaust valves should be well lubricated to prevent sticking, a suitable lubricant being a mixture of kerosene and thin lubricating oil applied with a proper appreciation of the fact that too much lubricant is worse than too little. If the valves tend to stick, kerosene can be used alone before the engine has been stopped. The writer has found that too high exhaust temperature is the cause in the majority of cases of burned exhaust valves. This excessive heat may usually be traced to overloads, slow combustion or incorrect valve timing.

Special Material Should Be Used for Valves

The rate at which scale or deposits will form on the valve depends upon the temperature and material of the valve. As long as it wears down evenly and does not tend to chip no serious trouble will follow so that the material that scales the least and does not oxidize to any great extent is the most suitable material for valves. Cast iron is preferable to ordinary machinery steel though at the present time there are alloy steels on the market which should be used for this service except in emergencies.

If the engine has peepholes in the exhaust connection, it is possible to gain a knowledge of the combustion conditions; if the peepholes are not present it is worth the time and effort expended to drill them even if it is necessary to go through the water jacket. In regulating combustion no red flame or smoke should be allowed. While regulating combustion a popping sound is often heard, due to fuel burning in the exhaust connection. If the leak is not bad enough to cause a flame it can still be detected by a sharp hissing sound exactly in time with the opening of the fuel valve. The best time to detect a valve leak is when the fuel supply has been shut off and the engine is coming to a stop.

Inlet valves do not require as much attention as exhaust valves but better performance may be expected if they are ground at least every six months. Those readers who have experienced the job of cleaning exhaust valves know what an unpleasant task it is but the unpleasant part can often be eliminated by interchanging inlet valves with exhaust valves for a period to let them burn clean.

When grinding valves a suitable jig or vise to hold the valve is necessary in order to save time and do a good job. For the best results in grinding a fairly soft wheel should be used as I have found that with a hard wheel the bonding does not permit the emery to

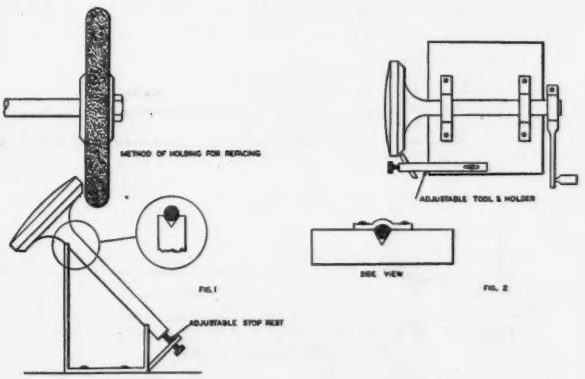


FIG. 1. A GOOD GUIDE HELPS DO A GOOD JOB OF VALVE GRINDING
FIG. 2. FACING VALVES WITH A TOOL CAN BE FACILITATED BY THE USE OF THIS DEVICE

disengage itself fast enough to keep the wheel sharp. This results in the wheel becoming glazed and useless as far as grinding is concerned. A convenient method and jig for the grinding of valves is shown by Fig. 1, with the valve stem steadied in a V-guide. For facing valves a hand-operated device, shown by Fig. 2, can be put together in a short while usually from materials found in the scrapheap. If the feed is by hand, care must be taken so that the tool does not bite into the work. A few minutes spent in proper attention and grinding of valves eliminates many hours of work in Diesel maintenance and pays large dividends.

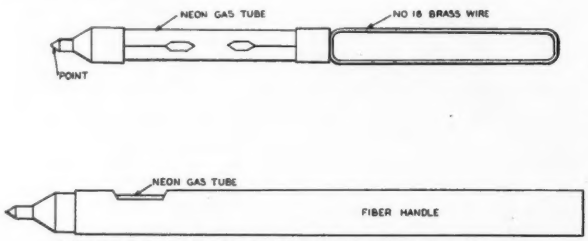
New Cast Irons

Two new materials, Silal and Nicrosilal types of heat-resisting cast irons have been developed by the British Cast Iron Research Association according to a paper presented at the American Foundrymen's Assoc. Silal contains 5 per cent silicon, and the balance cast iron. Nicrosilal which in addition to the silicon contains more than 17 per cent nickel and 3 per cent chromium, represents an advance over Silal because of its much better stability and of its resistance to cracking and heat shock commonly encountered in castings used for grate bars, stoker parts, stove and furnace parts.

Readers' Conference

Are Your Equipment Cases Alive?

FATAL ELECTRIC shock occasionally results from the case of a transformer, or the frame of electrical equipment becoming charged with a high voltage current. This is generally due to defective bushings, wire insulation, or oil, dirt and carbon particles collecting on an exposed surface and thus forming an electrical path from some live part to the frame or case. It is impossible to determine by the eye, if the case is alive. Consequently, most employes of industrial plants and electric companies have a feeling that machines are perfectly insulated and form the habit of touching the equipment whenever they desire. This may be done many times without accident, but coming in contact with 1000 v. or more once may prove to be the cause of a fatal accident.



DEVICE FOR DETECTING LIVE CONDITION OF TRANSFORMER CASE

It is the object of this article to pass along to others an instrument that was devised by the Superintendent of one company employing 5000 transformers of various sizes, for testing the transformer cases to determine if they were alive.

The instrument shown in the accompanying illustration was designed for this purpose. It consists of a neon gas-filled tube 13/16 in. in diameter and 4½ in. long. There is a brass ferrule on each end that is connected with the two electrodes encased in the gas-filled chamber. A glass tube fills the intervening space between the two ferrules and allows inspection of the electrodes to determine when they glow. To one end is sweated a point and to the other a brass wire of 16 gage 4½ in. long and looped as shown. The entire outfit is enclosed in a fiber tube 10 in. long and 1/16 in. thick. A slot 1½ in. long and ¼ in. deep is cut in the fiber tube directly over the electrodes to permit inspection.

A word might be said about the theory of neon gas and the principle of the operation of the tube. Neon gas is a low resistance conductor of electricity. There are two electrodes enclosed in neon gas, one in contact with a high voltage, the other given a capacity effect by holding the tube in the hand with the wire directly under the palm. A circuit is then set up and current tends to flow from one electrode to the other. The points of the electrodes are heated and glow, thus emitting a pale rose-colored light. The nearer the hand to the tube the more brilliant the glow. If the person holding the tube is wearing a rubber glove the effect upon the glow is hardly noticeable. As an extra precaution, when working on circuits of 2000 v. and higher, it is best to wear a rubber glove.

Best results are obtained upon a grounded system, but tests show that some light will be emitted from an undergrounded system. Some tubes have been found to glow on a grounded system as low as 400 v., the average being between 800 and 1000 v. There is little difference in the brilliancy between 800 and 1500 v. At 2000 v. or more a very bright glow is obtained.

The following procedure should be used to obtain satisfactory and positive results as it has been found that occasionally a defective neon gas-filled tube may be obtained. A firm grasp should be made on the fiber tube with the thumb about 6 in. from the point or exposed end of the tube. Then place the point on the insulation of a live primary wire and notice if the tube glows. If it does, immediately place the point against the case or frame to be tested, making sure good contact is made, and again notice if the tube glows. If it does, the frame or case is alive and should not be touched with bare hands under any circumstances. After the test is made on the case the point should again be placed on the primary wire as a check to determine that the tube is functioning properly. This procedure should be followed regardless of whether a glow is obtained on touching the case or not as a positive check is essential.

The instrument was designed primarily for use in testing transformer cases but there is no reason why its application cannot be extended to other equipment using high tension voltages.

Many in the industry have been operating high voltage equipment for years with little thought but what bushing and wire insulation are in as good condition as the day they were purchased. This may be true, but with age there is a possibility that some piece of equipment has become defective and may be the cause of an accident.

The instrument shown is inexpensive and requires little time to construct. Its use and value in locating one defect in several years could not be calculated in dollars and cents. A routine calling for the use of such an instrument by employes working with high voltage equipment might be well worth the small trouble involved by the prevention of accident.

Long Island City, N. Y. J. DUDLEY PEASE.

Making Anti-Friction Bearings Long Lived

IMPROPER INSTALLATION and care are two reasons why ball and roller bearings commonly fail prematurely. When installing it is just as important to protect the bearings against dirt and grit as it is to attend properly to all of the mechanical details of alinement, housing and oiling.

Many installers of anti-friction bearings seem to think nothing of the extreme care with which the manufacturers cover the bearings with rust preventive, wrap them, and seal them, so that dust, grit, and moisture cannot get in.

When installing anti-friction bearings, an excellent

method is thoroughly to clean the housing in which the bearing is to be installed. Blow with compressed air, if available. Wash with gasoline. Wipe clean with new wrapping paper. New paper is preferred to rags or cloth because paper does not leave lint and is not likely to make the surfaces dirtier because the paper is new. The objection to rags is that they are commonly used until they themselves become seriously dirty. Care exercised in keeping dust and dirt out of the bearing is paid for over and over in longer bearing life.

Smoothness of bearing surface is of supreme importance. Just as soon as the surface becomes the least bit rough it ceases to operate silently and smoothly and its coefficient of friction increases. Expose an unprotected highly polished surface to the atmosphere and it is likely to pit in a surprisingly short time. Yet we frequently see spare bearings exposed to the atmosphere, steam, and corrosive gases—bearings which may not be put into use for months or years. Wrappings are sometimes carelessly removed and the protecting layer of rust preventive is rubbed off in spots. As a result, even before the bearing goes into service, it is ruined.

After the bearing is installed, lubrication is most important. Never use a lubricant that has graphite in it. Owing to the fact that it is a solid, graphite has ruined many a ball bearing. Use a lubricant that does not vaporize easily, otherwise if the bearing is not used for some time the lubricant will evaporate from the balls and surfaces not immersed in the oil, exposing the surfaces to the atmosphere, moisture and gases, and pitting will be the inevitable result. Properly designed bearings seldom require re-oiling and for that reason as well as for the protection of the bearing it pays to use a high grade lubricant. For instance I have in mind a case where upon installation the proper oil was used. Never use an animal or vegetable oil on anti-friction bearings. Such oils commonly break down and form acids and alkalis. Use only the purest mineral oil.

Finally, and briefly: (1) use anti-friction bearings of correct size; (2) use the correct type; (3) install them correctly; (4) use a high grade mineral lubricant; (5) take good care of the bearings; and (6) be sure that your spare bearings are generously covered with a good rust preventive, wrapped and sealed.

Newark, N. J. W. F. SCHAPHORST.

Water Hammer in a Lancashire Boiler

ONE OF OUR Lancashire boilers working at 120 lb. steam pressure would bang severely when the water fell very low in the gage glass and the feed pump was working. The banging seemed to originate around the feed inlet. An internal examination of the boiler showed that the feed inlet pipe was double bent, so that a short length of pipe near the front end would be above water when the water level was low.

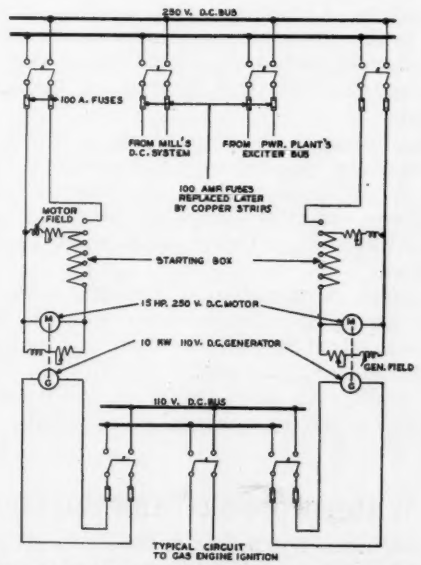
This should not have caused any difference as water was not delivered at this end of the pipe. An examination of this length of pipe showed that a fracture had developed, this was sufficiently large to permit water to escape when the feed pump was working, and when the water level was low, the water escaping from this fracture would come in contact with the steam causing water hammer. As the section of the pipe fractured was not subjected to severe stress a welded repair was decided on. After the repair there was no further water hammer.

Welwyn Garden City, Herts, England. W. E. WARNER.

Operator's Carelessness Shuts Down Large Steel Plant

CARELESSNESS in a power plant will often start a chain of events leading to the climax of serious trouble. For proof, witness an occurrence in the main power plant of a large middle-western steel mill where an operator in a heedless moment caused a complete shut-down of its entire electrical system consisting of 42,000 kw. of generators, numerous rolling mills and a large quantity of auxiliary equipment.

This steel mill has its generating system interconnected with those of two other subsidiaries of the same corporation. None buys power from a public utility; therefore, in case of failure of its generators, any one system must depend upon its own resources or upon a supply of energy from a subsidiary in order to start operations again. The system of the first plant consists of three power stations interconnected by tie lines. Two of these stations have gas engines as prime movers which use gas from the nearby blast furnaces. To explode this gas, ignition in each station is supplied by one of two motor-generator sets whose connections are shown in the accompanying diagram.


250 V. D.C. BUS
100 A. FUSES
FROM MILL'S D.C. SYSTEM
FROM PWR. PLANT'S EXCITER BUS
100 AMP. FUSES REPLACED LATER BY COPPER STRIPS
MOTOR FIELD
STARTING BOX
15 HP. 250 V. D.C. MOTOR
10 KW 110 V. D.C. GENERATOR
GEN. FIELD
110 V. D.C. BUS
TYPICAL CIRCUIT TO GAS ENGINE IGNITION

ELECTRICAL CONNECTIONS IN STEEL MILL

On the day the events here described took place, the electrical equipment of the entire plant was operating normally. To the largest power station a new operator came for training. As it happened, the customary maintenance work was being done on the spare ignition set. To help, he slotted the commutator of the motor in order to remove an accumulation of dirt. After completing this task and desiring to test his work, he started the motor by closing its knife switch and bringing up the handle of its faceplate starting box. When the latter had completed about half of its full stroke, the motor commutator flashed, a squeal was heard and the plant's equipment generating or using electrical power shut down.

The flash was a short-circuit and the squeal was the noise made by it. As was found out later, the operator did not remove the burrs made by the slotting tool on

the edge of the commutator bars before he started the motor. When it rotated, these rough edges scraping against the graphite brushes caused a film of conducting material to form between the brush-holders. As the resistance of the starter was decreased, the voltage impressed upon the armature increased until it was high enough to cause excessive current to flow through the graphite path. The current of the resulting short-circuit came from the power station's exciter bus—the other source from the mill D. C. system is for emergency use—through the 100 amp. fuses of the main switch and then through the switch and fuses of the individual motor circuit.

Since the main fuses were carrying the load of the motor operating normally in addition to that of the motor being tested, they were the most heavily loaded and, therefore, blew. In doing so, the power source was removed from the set supplying ignition to the gas engines. Their consequent failure forced all the gas-engine generators of this power station, one-half of the plant's total capacity, to shut down. This load thrown suddenly onto the generators of the other two stations stalled them. Consequently, the entire burden was shifted to the other subsidiaries and the resulting high flow of current made the overload relays open the line connecting all three, thus abandoning the steel mill to its fate.

For an original source of power, a 7000-kw. steam turbo-generator was used since it was kept at near normal speed by good work of its engineer. Exciters, ignition sets and other generators were soon operating and the wheels of industry again began their accustomed hum.

To avoid a repetition of having trouble on one ignition set being reflected onto the other, the main fuses were cut out by replacing them with copper strips. But, nevertheless, this shut-down with its disastrous results could have been avoided if the operator had used ordinary care by thinking before acting.

Hammond, Ind. S. EIN

Waterproofing Tank Surface

THERE ARE a few points in the article on p. 316 of the June issue on painting the inside of a water tank, that I would like to direct attention.

Linseed oil films, under a high power microscope, show an appearance like a fine screen; this is an excellent thing in painting over wood, as it allows gases from the drying wood to escape, but it is a bad thing when used over steel. In preparing the surface, the important thing is to remove all rust spots, absolutely. A simple scratching with a putty knife is not enough. Then grease or oil spots should be removed, but solvent naphtha is a dangerous thing to use in a small tank, on account of the toxicity of the fumes. Turpentine is equally objectionable, but painter's naphtha less so. In a general way, wiping with a handful of dry waste will suffice, as tests by the Scientific Section of the Paint Manufacturers' Association showed that paraffine oil up to 20 per cent did not impair the durability of the films. This does not apply to painting over wooden surfaces.

Red lead and linseed oil is an excellent protection for steel, being surpassed only by American Vermillion (basic chromate of lead), which has the drawback of being very expensive by comparison. Red lead, though, should never be left alone, as it is converted to carbonate by the air, as pointed out before, the film is not absolutely waterproof. For this reason, red lead should be used as a priming coat, and any color desired can be used for the second coat, black or red oxide being preferable, as black shuts off all the rays of light, and red shuts off all but the infra-red rays which are least destructive of oil films. The body of the second coat should be wood oil, which is our most waterproof coating.

This can be easily tested by flowing oil films over a black surface and pouring boiling water on them when dry. The linseed oil film will turn white by absorption of water, but will resume its transparency when dry. Wood oil in the raw state is not very satisfactory, as it dries with a crinkly film, but varnish made from it, with a minimum of rosin, makes a very satisfactory paint medium. The cheaper grades on the market are frequently loaded with rosin, the actual oil content being about 30 per cent; still, at that, it is a better waterproofing agent than linseed oil.

While the question does not state, we have assumed that the tank is steel. Should it be a wooden tank, the same rules will apply except that the wood must be absolutely dry before painting, and red oxide, which is cheaper, may be used in place of red lead for the priming coat, and a little solvent naptha used in the paint to give penetration on yellow pine, fir or cypress.

St. Louis, Mo. L. R. BAKER

Motor Foundation

REFERRING to G. A. Luers' suggestion for changing a foundation pad to accommodate a new motor base (June, 1933, page 270). It is not clear from the description or sketches whether the old foundation bolts were used to secure the wood flooring to the old foundation. Let us assume that this was done, for otherwise the new foundation bolts would be of no use at all. Even at that it is doubtful if this is really a good way of securing a motor base to its foundation. In time the bolts are bound to work loose in the wood flooring (even if it is *oak*) and cause unwanted movement of the motor base. Besides, the suggestion would work only when the distance from center line to base of the new motor is at least 2½ in. less than that of the old one, which is not always the case. This last reasoning is only true when the motor is direct-connected to the driven machine. For a motor with a belt drive the height will naturally make no difference.

A much simpler way, applicable to all cases, is to cut off the old bolts level with the foundation pad, using an oxy-acetylene torch, or a hacksaw, or a cold chisel. With an air drill make new holes of any desired depth. Shape the holes conically, wider at the bottom than at the top of the pad. Set stone-bolts or rag-bolts in these holes to suit the new base, pour fresh concrete in the holes and level off the top to suit. If, in case of a direct-connected motor, the distance from center line to base of the new motor happens to be greater, the top of the old foundation must be previously chipped off with an air chisel to suit. The oak strips with the rubber pads for resilience may be used with this method also.

Pittsburgh, Pa. BERNARD KRAMER.

Sixth Chicago Power Show Held in Stevens Hotel

CONCENTRATION OF ACTIVITIES IN LOOP DISTRICT DURING ENGINEERING WEEK CAUSES SHIFT IN LOCATION

EXTREME DIVERSIFICATION together with the absence of heavy equipment changed the character of the popularly known Chicago Power Show and brought it closer to its broader official title, The Sixth Midwest Engineering & Power Exposition, than has been the case in the past. At a comparatively recent date the show, held June 27 to 29, was shifted from the Coliseum to the Stevens Hotel in order to bring it closer to the activities concentrated in the Loop district of Chicago during Engineering Week. Unusual activity brought about by a score of society conventions and the World's Fair detracted somewhat from the attendance, a fact apparently anticipated by many companies as the exhibitors, listed on the official program, were well under a hundred.

GROUPED EXHIBITS

Many of these were grouped around the central booths of Chicago sales agents, the largest group ranging from instruments to piping being represented by Himelblau-Agazim Co. Steel and wrought iron welded fittings of the Midwest Piping & Supply Co. were exhibited opposite the Midget trap, a new small trap furnished with a union for direct attachment to radiators, of Kay & MacDonald, Inc., and representative Red Head traps of The Ellis Drier Co. Moeller Instrument Co. Red Line glass thermometers were shown in service on an Ames Pump Co. Model E pump and receiver set which uses a vertical centrifugal pump incorporating, on the same shaft, a hurling water impeller and a boiler feed impeller. Feedwater regulators, pump governors and valves of the Chaplin-Fulton Mfg. Co. and electric control valves of the Automatic Valve Corp. for liquid or gas refrigeration lines, especially adapted for the use of Freon, competed for interest with the Coppus Eng. Co. Heat Killers, the new unit heaters of the Antherm Mfg. Co. (formerly Skinner Bros. Mfg. Co.) and the new grills, registers and deflectors of the Uni-Flo Grille Corp. designed so as to give but a 5 per cent reduction of air flow as compared with an unobstructed opening. Perhaps the most interesting part of the exhibit was the glass wool air filters of the Owens-Illinois Glass Co. now available in paper cartons or frames so cheap that the entire cell is thrown away after use and replaced with a complete new one.

Cochrane Engineering Co. exhibited a full size soot cleaner head of the Bayer Co. and the well known but always interesting vacuum vapor power plant of the Cochrane Corp. working on the heat head between wet and dry bulb temperatures.

Barrett-Christie Co. featured in one booth Armstrong Machine Works, in the other Black & Decker Mfg. Co. portable tools and a new high pressure direct return trap of the Johnson Corp. to be built in 5 sizes for direct return, lifting or vacuum service. The Armstrong Machine Works featured the recently introduced Armstrong Thermic Unit, a device to increase the air handling capacity of inverted bucket traps. This device consists of an auxiliary air vent closed by means of a flat bimetal spring installed at the top of the trap bucket. With the trap cold the strip holds the valve disc away from the vent but as soon as steam enters the trap the strap closes the auxiliary valve and the trap bucket functions in the normal manner.

Engineering Sales Co. exhibited Kieley & Mueller, Inc., new liquid level controllers with the ball bearing spindle, hydraulic damper controllers and cutaway models of regulating valves; E. B. Badger & Sons Co., new corrugated expansion joint with directed flexing of the compensating members; and a full size propeller type exhaust fan of the Bendix Products Co., designed to fit in a breeching and act as an induced draft booster on units laid out for natural draft.

In the American Leather Belting Association exhibit, participated in by Chicago Belting Co., Graton & Knight Co. and J. E. Rhoades & Co., a 30-hp. installation was in operation to show the comparative performance of V belt and flat leather belt drives; short center drive arrangements and the newly designed ceiling and overhead pivoted bases.

FEEDWATER TREATMENT

Perhaps the largest single industry representation was in the field of feedwater and boiler water treatment. Dearborn Chemical Co. placed emphasis on the use of the laboratory and had a chemist present making common water tests and instructing visitors in the proper technique. Graver Tank & Mfg. Corp. featured the hot process softener by means of a colored Scene-in-Action illustrating the operation of a typical treating plant. Scientific boiler water treatment "As Simple As A. B. C." was the theme of the National Aluminate Corp. exhibit. This Nalco AB system supplements the K.W.S. System and consists of moulded balls, in one aluminate and soda in the other organic material and soda ash, making it possible to meet the varying needs of specific conditions. Elgin Softener Corp. exhibited its new auto concentrator, a simple electrical instrument for determining concentration of boiler water and also showed in operation for the first time the glass boiler complete with Zeolite treatment and deconcentrator. A clean boiler story outlining the accomplishments of the Hagan Corp., Hall Laboratories and The Buromin Co., in boiler water treatment was featured in a projector by the Hagan Corp. This was supplemented by a large 16 pp. mechanical book telling how the company has profited

by the depression and showing improvements in its several products.

Instruments

Instruments played an important part in the show, the newly designed Republic Flow Meters Co. cases with strips of polished aluminum and the new cartridge sealed elements creating a great deal of interest. Full size instruments with the octagonal recorders and a multiple unit flat face boiler indicator panel were on display to show the attractive appearance, accessibility and convenience of the new designs. Another new meter exhibited was the Foto-Flo meter of The Tremount Instrument Co., a flat plate orifice type using an indicating and recording mercury manometer. The fluctuating mercury column between a light source and light sensitive chart acts as the recording mechanism. Among the complete instrument exhibit of the Hays Corp., $SeezO_2$ a new oxygen absorber unaffected by light and for use with flue gas analyzers was the big feature. E. Vernon Hill Co. exhibited a new portable compact draft gage using cigarette or cigar smoke and Barber Coleman Co., among its large exhibit of motor operated valves and dampers, featured a new hygrostat using a human hair element which is rugged and yet extremely sensitive to moisture changes. Alnor resistance thermometers with a 10 point indicator for reading outside and inside temperatures from a common station was the newest instrument among the extensive temperature measuring equipment exhibit of the Illinois Testing Laboratories, Inc. Closely related to instruments because of the extensive use made of copper tubing and fittings was the exhibit of the Parker Appliance Co. showing the use and application of these parts for instrument and copper plumbing applications.

Valves and Control Equipment

Valves of all types, sizes and services were on display making perhaps the broadest and most complete showing of any single division of equipment. A new electric temperature regulator operating in six definite steps was featured by the Sarco Co. In this a thermostatic actuator operates relays controlling the power input to a small heat motor to open and close a valve. In the comprehensive exhibit of The C. E. Squires Co., a large size dead end reducing valve designed to reduce from 500 lb. to a few ounces in one step, and made in sizes ranging from 1¼ to 12 in., was the center of interest. Barco Mfg. Co. exhibited its flexible joint for various services emphasizing the new power reverse gear valve for locomotive service and a new universal joint for tailor and laundry machines. Equipment for mixing steam and water for industrial purposes requiring large quantities of accurately mixed water and hot and cold water mixers for domestic or industrial uses were shown by the Fulton Sylphon Co., the temperature control actuator in all cases being the widely used Sylphon bellows. Powers Regulator Co. exhibited many of its standard chromium plated valve and control equipment, one in the newest devices being the No. 23 regulator for air conditioning purposes. Larger valves of bronze, iron, steel and corrosion resistant materials were prominent in the Wm. Powell Co. exhibit which also included a new mechanical lift plug valve for pressures of from 150 to 200 lb. up to 12 in. size and at the opposite extreme a small 250 lb. electric control valve operated by a solenoid. Valve reseating and repair kits for valves up to 3 in. were shown and demonstrated by the Saver Renewable Seat Tool Co., thus making the valve exhibits complete for those interested either in repair or replacement.

Miscellaneous

Because of the diversity of equipment and the small number of exhibitors many manufacturers had products difficult to classify in the above general divisions. A new cork fiber sheet packing known as 660 and soft enough to seal flanges or joints imperfectly machined yet tough enough to permit its use in paper thicknesses for thin gaskets was featured by the Garlock Packing Co. Advances in metallurgy were shown in an extensive exhibit by The International Nickel Co., Inc., a moving picture showing the many activities of the research laboratory of the company, various specimens showed the properties of common and heat resistant irons and steels, while large movable charts pointed to the properties and compositions of irons and steels for various services. Properties, advantages and use of Nonpareil turbine oil was shown by the Standard Oil Co. in an exhibit showing the oiling systems of two small steam turbines. Keasbey & Mattison Co. had an attractive switchboard with instruments and lights showing the application of its Ambler Ebonized asbestos for this service. Ehret Magnesia Mfg. Co. showed many of its magnesia products and featured the use of flue and stack lining and its new high temperature insulation for very high temperature steam lines.

Coal exhibits were of interest. Sauerman Bros., Inc., demonstrating the use of power scrapers and stack line scrapers working on the storage and reclaiming of coal; the Old Ben Coal Corp. showed a working model of one of its mines and the Chicago, Wilmington and Franklin Coal Co. samples of its new Air Washed stoker coals from which the dust has been removed. Yale & Towne Mfg. Co. demonstrated many hoist models and had a small Tri-rotor pump in operation. Among other machines, Model 72, a new portable industrial vacuum cleaner weighing 30 lb. was shown in operation by the Breuer Elec. Mfg. Co. Hexteel, a hexagonal and continuous steel surface for concrete, terrazzo, asphalt or mastic floors was featured by the William F. Klemp Co., Inc. Tools for laying the sections, clamping together and anchoring to old or worn wood floors or stairs were demonstrated and finished sections of the floor were available for inspection to show how the steel sections take the weight and wear from the floor surface proper.

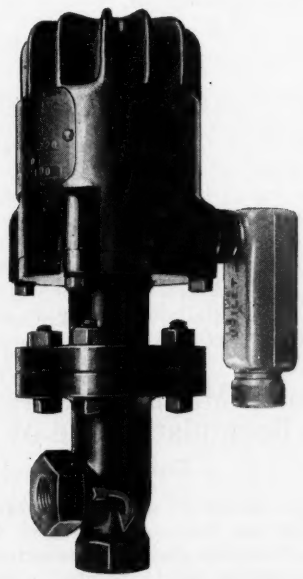
Corrosion and heat resistant cast iron, with the same coefficient of expansion as plain iron at elevated temperatures, was recently announced by The International Nickel Co. Its composition is 28-32 per cent nickel, 4-5 per cent chromium, and the balance cast iron. The new material is tough, machinable and maintains its properties without deterioration at high temperatures.

It is particularly suited for construction requiring heat or corrosion resistant metal in contact with plain cast iron or steel, where the alloy is used as a liner or insert and attains a higher temperature than its surroundings and must consequently pass through the heating and cooling cycles without becoming separated from the base metal enveloping it.

New Equipment

Electric Control Valves

FRICK Co., Waynesboro, Pa., has developed an automatic, packless valve that can be used as a shut-off in either the liquid or suction lines of refrigerating plants having one, two or more boxes to control. The valve is operated from a thermostat or relay and can be installed either inside or outside the space to be cooled. It is applicable to plants charged with ammonia, methyl chloride, or freon, and can also be installed as a control for brine or water. When used to open a bypass



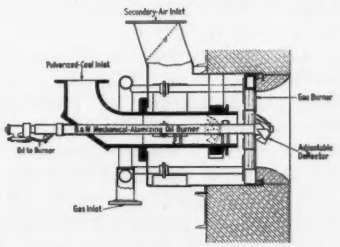
on a compressor, during starting, the electric control valve provides a quick-acting, positive unloader. This arrangement is of advantage both for full automatic plants and as a time saver in plants otherwise manually operated, having several compressors.

The valve itself is opened and closed by the action of a plunger working inside a magnetic coil. This plunger is enclosed in a gas tight tube, which extends clear through the magnetic coil, and eliminates any necessity for a packed sliding joint around the valve stem.

Cutting of the hardened seat is avoided because the valve is always either wide open or tightly closed. When closed, the pressure of the liquid or gas behind the valve keeps it tight. Valves of the three larger sizes are so arranged that, while opening, the pressure is relieved by an auxiliary port; the main valve when open provides full valve area. The electric coil is furnished for 110 or 220-v., 25, 50 or 60-cycle a. c.; also for 32, 115 or 230-v. d. c.

Babcock & Wilcox Circular Multi-fuels Burner

BABCOCK & WILCOX Co. has recently put on the market a new burner adapted to combination firing through refractory burner walls and consequently suited to small and moderate size industrial boiler units. This burner is of the hori-



zontal turbulent type, employs mechanical atomization when burning oil. Liquid, gaseous or solid fuels in pulverized form may be injected into the furnace through a common circular throat opening, either one at a time or in combination. Adjustable deflector, mounted at the furnace end of the primary-air and pulverized coal pipe, insures intimate mixing with the secondary air and furnishes a high degree of turbulence.

New Collector Ring Grinder

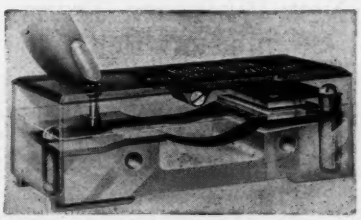
TRUING COLLECTOR rings has always been a serious problem in the operation of rotating alternating current equipment. To overcome the difficulties involved, the Ideal Commutator Dresser Co. of Sycamore, Illinois, has recently placed on the market a new collector ring grinder which has many desirable features. It consists of a head carrying grinding stones supplied with three different types of supports. Two short supports will take care of brush arms spaced from 5 to 6½ in. while a long support is for brush holder studs spaced from 6½ to 8 in. Both brush arm supports are adapted for 1¼ in. diameter brush holder studs, although when studs are smaller, suitable split bushings or sleeves can be furnished for any size of stud.

This grinder, it is claimed, was developed by an electrical maintenance superintendent of one of the largest electric power companies in this country. With its use machines need not be dismantled and can be put back to 50 per cent service in just a few minutes. They are furnished for grinding iron, steel, bronze and brass ring grinding.

Burgess Micro Switch

THROUGH NOVEL design and the use of the new beryllium copper alloy, The C. F. Burgess Laboratories, Inc., have developed a novel electric switch which is operated by extremely small actuating movements. In highly compact form, requiring only one thousandths of an inch movement and a few ounces' pressure for positive operation, this quick-acting switch is capable of handling sufficient current for the majority of electrical control functions. It is, in effect, an electrical hair trigger ready to be applied between delicate controlling impulses and powerful controlled forces.

Contained in a neat, dust-proof, molded phenolic case, the Burgess Micro Switch measures 1 15/16" long, 11/16" wide and 27/32" high. The body is black, while a colored top serves to identify the type of switch—red top, normally closed; green top, normally open; blue top, double-throw. All types are single-



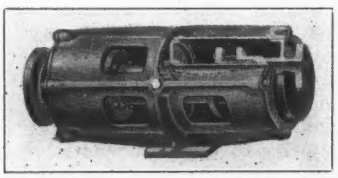
pole. A tiny plunger protrudes through the top and receives the slight energy required to operate the switch mechanism. Screw terminals are on the bottom of the case. The small motion required, combined with freedom from vibration difficulties, and again the fact that

this switch can be used in any position, suggests its use in many industrial, laboratory, scientific and other instruments and appliances. It is mounted by means of two No. 6 machine screws slipping through transverse holes in the case.

The use of beryllium copper for contact springs provides freedom from fatigue or crystallization in millions of operations; a permanence of original operating characteristics, and no deformation even under heavy pressures; high current-handling capacity; extreme speed without sticking; and the ability to withstand high temperature.

Direct Externally Guided Expansion Joint

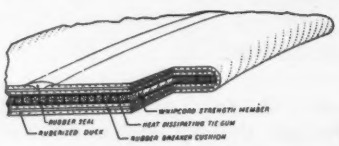
THE DIRECT SEPARATOR CO., Syracuse, N. Y., has recently developed a double slip externally guided expansion joint in which the sliding member is composed of the stuffing box and guides; the external guide being enclosed with the cylinder extending the full length of joint and



the internal guide inside the stuffing box and adjacent pipe section. The external part is a single substantial casting, strong and heavily ribbed and carefully machined, concentric with all sliding parts so that all parts are continuously in line. Ample openings are provided for repacking. These joints may be secured in all sizes, standard and extra heavy, and of cast steel if desired.

New Whipcord Transmission Belt

MANHATTAN Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J., announces the new



Condor Whipcord transmission belt. This belt is of the continuous-endless-wound whipcord construction, with no inelastic stretch and was developed after years of research with high speed, high tension drives. Flexibility and strength are the advantages claimed for this construction.

Four-Duty Coupling

THE FALK CORPORATION, Milwaukee, Wis., has announced the Falk-Rawson 4-Duty coupling designed to perform four important duties, to start, couple, cushion and limit the load.

The primary function of the coupling is as an automatic starter, centrifugally operated. Essentially, the construction involves merely two drum-shaped members, one attached to the driving shaft and the other to the driven shaft. Between driving and driven members are inserted two sets of floating segments, made usually of brake lining reinforced with lead; the amount of lead being calculated to give the required centrifugal pressure for carrying the load. The outer segments are actuated by the driving member and the inner by the driven member. The two give just the right combination of smooth starting and overload protection.

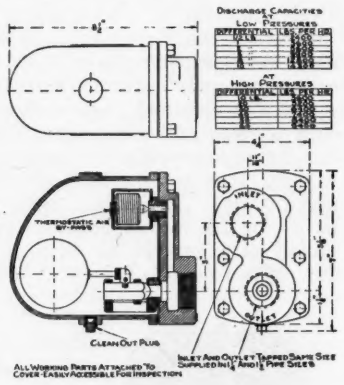
Expansion Joints for 400-lb.

COMPLETE LINE of slip expansion joints for 400-lb. W.S.P. has been developed by the American District Steam Co., North Tonawanda, N. Y. The joints are of the

internally-externally guided type provided with specially designed, rugged anchor base. The chromium plated steel slip is guided at both extreme ends throughout its entire travel, assuring a straight and true movement of the slip. Of especial importance is the fact the greatest diameter of the joint is only slightly larger than the connecting flanges. These joints are manufactured in all sizes in the single and double slip type, with or without anchor base and with or without service connection.

New Sarco Trap

DESIGNED ESPECIALLY to handle condensation in large quantities and in sudden rushes such as in unit heaters or pipe coils service a new



trap is being offered by the Sarco Co., New York, N. Y. It has a 1½ in. inlet and outlet, both in front, a vertical distance of only 3 in. apart. All working parts are on the cover, easily accessible by removing the trap body without disturbing pipe connections. A boss is provided on top of the body, in line with the cleaning-out plug, for easy installation of a gage glass when desired.

Boiler Manufacturers to Formulate Code of Practice

IN ORDER to serve the industry under the National Recoverey Act, the American Boiler Manufacturers Association has appointed a committee known as the A. B. M. A. Committee of Industrial Recovery, consisting of Owsley Brown, Springfield Boiler Co., Chairman; A. C. Weigel, Combustion Engineering Corp., Vice-Chairman; Starr H. Barnum, The Bigelow Co.; H. H. Clemens, Erie City Iron Works; W. F. Keenan, Jr., Foster-Wheeler Corp.; R. B. Mildon, Stoker Dept., Westinghouse Electric & Mfg. Co.; A. G. Pratt, Babcock & Wilcox Co.; A. W. Strong, The Strong-Scott Mfg. Co.; and C. E. Tudor, The Tudor Boiler Mfg. Co.

The committee is preparing a Code of Fair Competition to be submitted to the Government for approval.

J. D. Andrews has been selected as Manager. Offices have been established at 253 Broadway, New York City.

News From the Field

THE FEDERAL POWER COMMISSION has just issued a decision indicating that it will not allow more than $9,642,673 to the Chelan River Water Power Co. on its project on Chelan River, in the State of Washington, for construction costs on its project. The company had requested $11,067,055 which included interest for 20 yr. on its cost. Since construction had not been pursued for 17 yr. of this period, the Commission determined that it was entitled to 3 yr. interest and cut off $1,424,382 from the alleged cost. Since this cut affects the charges to the consumer of the electricity of this project, the Commission calls attention to the fact that the saving to the public will be appreciable in this case.

REUBEN H. BARBER, head of the steam engineering division of the International Paper Co., was fatally injured in an automobile accident which occurred about 8 mi. from Hull, Que., on July 11. His home was at White Plains, N. Y., and he had held his present post about 5 yr. previously having served as chief engineer of the generating station of the Edison Gas & Electric Light Co., at New Bedford, Mass.

D. ROSS-WATSON recently connected with the construction and engineering of the Celanese Corporation of America, Cumberland, Md., is now affiliated with the Rockefeller Center, Inc., Radio Center, New York City.

THE CHAPMAN VALVE MFG. CO. of Indian Orchard, Mass., and the Automatic Cone Valve Co. of Mattoon, Ill., have made an agreement whereby the Chapman Valve Mfg. Co. has been given the exclusive right and license to the manufacture and sale of all products heretofore manufactured by the Automatic Cone Co. The entire personnel of the Automatic Cone Valve Co. has been retained by the Chapman Valve Mfg. Co. David D. Goldberg, previously general manager of the Automatic Cone Valve Co., will have direct charge of all Cone Valve sales work and engineering design at the home offices of the Chapman Valve Mfg. Co., Indian Orchard, Mass.

ANNOUNCEMENT is made by the Sarco Co., New York, of the following new representatives: E. R. Clement, Stratford, Conn.; Evans Construction Co., Scottsdale, Ariz.; P. J. O'Meara, San Francisco, Calif.; Geo. R. MacGregor, South Bend, Ind.; J. E. Pearson, El Paso, Texas, and C. H. Penningroth, Ft. Wayne, Ind.

GRAVER TANK & MFG. CORP. has recently shipped to the Globe Oil and Refining Co., Lemont, Ill., what is reported to be the largest shop assembled riveted cracking tower that has been made to date. This tower has a shell diameter of 12 ft. inside and 80 ft. in length. The actual overall diameter over a double riveted row of manheads and hinges is somewhere in the neighborhood of 13 ft. 10 in. The shipment was made difficult through the fact that there were only a limited number of cars in the country that are capable of handling these excessively heavy loads in combination with minimum vertical clearances and the necessity for spreading the load on three cars injected the problem of taking care of the offset weight in traversing these cars around curves, the weight being 232,400 lb. Large steel plate saddles, weighing over 18 t. were set on large bearing plates with center pins and these in turn were permanently mounted on the car frame at the proper point to meet the railroad's loading rules as regards distribution of weight. The tower itself contained 14 steel bubble decks, one trap-off deck, together with a large heat exchanger which was in the chamber at one end.

THREE LARGE TRANSFORMERS which will eventually handle power generated at Boulder Dam, through the municipal transmission system have been ordered by the City of Los Angeles from the Westinghouse Electric & Manufacturing Company. The transformers will cost approximately $150,000 and will be rated at 20,000 kv-a. each. They will be manufactured at the Sharon Works of the Westinghouse Company.

DEARBORN CHEMICAL CO. announces the promotion of Edward J. Bade from a position in the Laboratory to the Sales Department of the company. He will follow the work of A. C. Herrmann on the south side of Chicago. Mr. Herrmann is entering into a business partnership with his father in Wisconsin.

THE RILEY STOKER CORP. has moved its Pittsburgh office from 1419 Farmers Bank Building to 1420 Investment Building, 239 Fourth Avenue. Van A. Reed, Jr., and L. C. Frohrieb will be in charge of the new office.

FISHER GOVERNOR CO. of Marshalltown, Iowa, has announced the appointment of M. N. Dannenbaum Co., 304 Shell Building, Houston, Texas as the direct factory representative in Southern and Eastern Texas.

SULLIVAN MACHINERY CO. has recently announced that the St. Louis District sales office and warehouse have been combined under the direction of D. M. Sutor as manager and is located at 2639 Locust Ave., St. Louis, Mo.

For the Engineer's Library

AN ILLUSTRATED CIRCULAR giving complete information on Westinghouse Thermoguard motors and their applications has recently been issued by the Westinghouse Electric and Manufacturing Company. These new self-protected motors may be used on all applications with the assurance of full protection under all conditions of operation, however extreme. Should the motor windings become dangerously overheated, the motor may be so connected to give a warning signal or to be disconnected from the line.

COPPER OXIDE RECTIFYING units are fully described in a new four-page leaflet issued by the Westinghouse Electric and Manufacturing Company. These rectox units, in addition to their use in battery chargers, have many industrial, central station and miscellaneous applications. The distinctive features of the elements and their application are described in the publication. This publication is known as Leaflet 20571. In another one (Leaflet 20570) Rectox Battery chargers are described. These are made up of rectox units and are supplied in various capacities for use on voltages up to 460 a. c.

TWO NEW OIL CIRCUIT breakers utilizing for the first time condenser bushings on small breakers are described in a recent 8-page publication issued by the Westinghouse Electric and Manufacturing Company entitled, Oil Circuit Breakers Types F-50 and F-100. These breakers are manually or electrically operated and are rated for indoor service of 5000, 7500 and 15,000 v. Designed for use in generating stations and industrial plants, they are especially applicable where a minimum space for switching equipment is available.

ATOMIC HYDROGEN Arc Welding Equipment is the title of a new 8-page bulletin, GEA-823D, issued by General Electric Co. This describes welding equipment for either hand or automatic operation. This form of welding produces unusually smooth, uniform, strong, nonporous, ductile welds. It can be used for the general welding of steel and ferrous alloys such as chrome, nickel and molybdenum steels or the nonferrous metals and alloys such as aluminum, duralumin, copper and brasses.

A 16-PAGE circular briefly describing electrical and steam equipment applicable to brewery operations has recently been issued by the Westinghouse Electric and Manufacturing Company. Switchboards, circuit breakers, gearing, temperature indicators, acid indicators, motors, gearmotors, lighting equipment, electric eye applications, steam jet refrigeration units, and other equipment are listed in this attractive publication.

GOULDS FLEXI-UNIT Centrifugal Pumps with capacities up to 4500 g.p.m. at heads to 350 ft. are made the subject of bulletin No. 203 recently issued by Goulds Pumps, Inc., Seneca Falls, N. Y.

D. O. JAMES MFG. CO., Chicago, Ill., has just published its bulletin No. 11 dealing with right angle spiral bevel gear speed reducers and gears which gives valuable data and specifications as to which this equipment is manufactured.

JAMES G. BIDDLE CO., Philadelphia, Pa., is distributing its bulletin 1355 which lists and describes five different types and 40 ranges of the company's Megger Insulation Testing Instruments.

THE HAYS CORP., Michigan City, Ind., has just issued two interesting bulletins, one designated as bulletin 2006, entitled "Handling the Orsat (Gas Analyzer)" and the other is entitled "Hays Flue Gas Analyzers and Portable Combustion Test Sets", designated as catalog TSE33. These bulletins contain a great deal of information on combustion as well as descriptive material on the Hays instruments.

MUNDET'S Cork Pipe Covering Price Bulletin date June 1, issued by Mundet Cork Corp., New York City, in addition to prices contains valuable engineering information on insulation, specifications, how to install when pipes are too close together for regular covering, how to order, and data on sundries for cork pipe covering.

Power Plant Construction News

Calif., Chowchilla—Danish Creamery Association, Chowchilla, plans construction of a new boiler plant in connection with new addition to milk and creamery plant. Entire project will cost about $55,000. W. D. Coates, Jr., Rowell Building, Fresno, Calif., is architect.

Calif., Elmhurst — Standard Brands, Inc., 595 Madison Avenue, New York, N. Y., plans installation of electric power equipment in new four-unit yeast plant, consisting of one, two and three-story buildings, at Elmhurst, near Oakland, Calif. Entire project will cost about $500,000. Bliss & Fairweather, Balboa Building, San Francisco, Calif., are architects.

Calif., Hayward — City Council is considering construction of a municipal electric light and power plant, estimated to cost about $240,000, with equipment. A survey and report on project has been made by Edward K. Hussey, Syndicate Building, Oakland, Calif., consulting engineer.

Colo, Denver — Bureau of Reclamation, Denver, will receive bids until August 18 for two or four 82,500 kv-a., vertical shaft, a. c. electric generator, and for one similar unit, 40,000 kv-a., each complete with main exciter, pilot exciter, thrust and guide bearings, surface coolers and accessories, for Boulder hydroelectric generating plant, Boulder Canyon project, Arizona-California-Nevada, as per Specifications 543.

Fla., Bradenton — Common Council is planning installation of steam-electric power equipment for municipal electric light and power plant. A new distributing system is also being considered. Surveys and estimates of cost will be made by E. V. Camp, Atlanta, Ga., who is consulting engineer.

Fla., Jacksonville — Clyde-Mallory Lines, foot of Market Street, Jacksonville, has plans for new multi-story precooling plant adjoining present shipping terminal. Estimated cost about $200,000, with equipment. Headquarters of company are at Pier 36, North River, New York, N. Y.

Ga., Rome—Tubize Chatillon Corporation, 2 Park Avenue, New York, N. Y., plans installation of electric power equipment in new addition to rayon mill at Rome. Entire project reported to cost over $400,000. J. E. Sirrine & Co., Greenville, S. C., are engineers.

Ill., Freeport—George and Mathias Schmich Estates, William H. and Frank Schmich, 1032 South Galena Avenue, representatives, plans installation of electric power equipment in connection with expansion and improvements in brewing plant. Entire project will cost close to $200,000. Fridstein Engineering Co., 229 North La Salle Street, Chicago, is engineer.

Ill., Peoria—Hiram Walker & Sons Inc., Union Guardian Building, Detroit, Mich., recently organized as a subsidiary of Hiram Walker-Gooderham & Worts, Ltd., Walkerville, Ont., distiller, plans construction of power house at new distillery on 15-acre tract of land at Peoria, recently acquired. Entire project will cost over $1,000,000. William J. Hume, president of parent company, will occupy same office with subsidiary interest.

Ind., Indianapolis—Richard Lieber Brewing Corporation, 1254 South West Street, recently organized, plans installation of power equipment, mechanical-cooling, conveying and other machinery for expansion and improvement program in plant of Midwest Brewing Co., location noted, which has been acquired. Program will cost over $200,000. Company has arranged financing for work. Richard Lieber is president. Freyn Engineering Co., 310 South Michigan Avenue, Chicago, Ill., is engineer.

Ind., Richmond—Richmond Brewing Co., Inc., Philip Stapp, president, Richmond, recently organized, plans installation of electric power equipment, mechanical-cooling machinery, tanks and other equipment in connection with remodeling of local four-story building for new brewery. Entire project will cost over $300,000.

Ky., Greensburg—City Council plans installation of high and low-lift pumping machinery and accessory equipment, elevated steel tank, 17,500 gals. capacity, on steel tower, and other mechanical equipment for extensions and improvements in municipal waterworks. Entire project reported to cost over $75,000. H. K. Bell, McClelland Building, Lexington, Ky., is consulting engineer.

Mich., Detroit—Goebel Brewing Co., Rivard and Maple Streets, plans construction of new power plant in connection with an expansion and modernization program. Entire project will cost over $150,000. Harley & Ellington, Inc., Stroh Building, is architect and engineer.

Mich., Lansing — Lansing Brewing Co., recently organized, care of Mildner & Eisen, Hamm Building, Detroit, Mich., architects, plans construction of boiler plant at proposed new brewery. Entire project will cost close to $200,000. Architects noted are in charge.

Minn., Red Wing—Red Wing Brewing Co., Inc., care of D. H. Mintz, president, Twin City Supply Co., 177 East Third Street, St. Paul, Minn. (manufacturer of bakers' equipment) head, plans installation of electric power equipment in connection with extensions and improvement in brewery. Entire project will cost over $200,000. Harry Whitsell, 964 Berry Street, St. Paul, is engineer.

Mo., Kansas City—Mid-West Brewing Co., Eighteenth Street and Agnes Avenue, F. E. Ransom, head. plans construction of steam power house in connection with new multi-story brewing plant. Entire project will cost close to $175,000. Company was organized recently.

Neb., Kearney—Kearney Ice Co., operated by Harry Tollefser, plans rebuilding of portion of plant, recently destroyed by fire. Loss about $25,000, with equipment.

N. Y., Brooklyn—Interboro Beverage Corporation, 28 George Street, plans installation of power equipment, mechanical-cooling and other machinery in new three-story and basement addition on Melrose Street. Cost about $300,000. Shampan & Shampan, 188 Montague Street, are architects. Edward M. Bluemenkranz is president.

N. C., Charlotte—Southern Breweries, Inc., Charlotte, care of E. A. Mees, 1317 Providence Road, engineer, recently organized, plans construction of power house at proposed new brewery at Hutchinson and Sylvania Avenues. Entire project will cost over $350,000.

Ohio, Kenton—City Council is planning construction of new municipal electric light and power plant. Cost estimated at 500,000, with equipment. Financing will soon be arranged. H. P. Jones, Second National Bank Building, Toledo, Ohio, is consulting engineer.

Ohio, Wilmington — City Council plans installation of pumping machinery and other mechanical equipment in connection with new municipal sewage disposal works and sewage system. Entire project will cost about $250,000. Financing will soon be arranged.

Pa., Beaver—Pittsburgh Coal Co., Oliver Building, Pittsburgh, Pa., plans installation of electric power equipment, hoisting and conveying machinery and other mechanical equipment in proposed new tipple and coal storage plant on Beaver Creek, vicinity of Beaver, for river-coal terminal in connection with new Montour Railroad. Entire project will cost over $150,000. Aaron Westlake is secretary.

Pa., Camp Hill—Borough Council plans installation of one or more electric-operated pumping plants in connection with new sewage system. Entire project estimated to cost $235,000. Christian L. Seibert is chairman of sewer committee. Albright & Friel, Inc., 246 South Fifteenth Street, Philadelphia, Pa., is consulting engineers.

Texas, Amarillo—Shamrock Oil & Gas Co., Amarillo, plans installation of air compressors, pumping machinery and other power equipment for expansion and development program in gasoline-extraction and oil refining plants in Panhandle oil district. Entire project will cost about $200,000. John Sheerin is president.

Va., Culpeper—Virginia Northern Ice Co., Staunton, Va., has approved plans for construction of new ice-manufacturing plant at Culpeper, with initial capacity of about 18 tons per day; a cold storage plant also will be installed, with capacity of about 140 tons. Cost over $60,000, with equipment. N. C. Taylor is general manager.

Wash., Chehalis—Canny Brewing Co., president, 1927 Third Street, Seattle, Wash., plans construction of boiler house, and installation of electric power equipment and other machinery for new brewing plant at Chehalis. Entire project will cost about $110,000.

Wis., Beloit—City Council is planning construction of new municipal light and power plant to cost about $133,000. Bonds in amount noted will be sold in August. Kenneth R. Brown, 1608 Harlem Boulevard, Rockford, Ill., is engineer.

Wis., Two Rivers—City Council, E. J. Donnelly, city manager, is planning financing in amount of about $240,000 for a new municipal electric light and power plant. Preliminary plans are being drawn by Burns & McDonnell Engineering Co., 107 West Linwood Boulevard, Kansas City, Mo., consulting engineer.